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VOL. XXXI NO. 1

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SPECIAL FEATURES

On the Cover: Closeup of the nose gunner of a Coast Guard Hall long-range patrol flying boat, with his heavy-caliber gun in firing position. The gunner is William M. Sikorski, 26, who has more than a year in the Coast Guard to his credit. Kodachrome by Rudy Arnold.

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NEXT MONTH

Inside Hitler's "Fortress Europe" the United Nations have allies who risk their lives every day fighting for freedom—they are the members of the Underground. When big British bombers by night, or American Flying Fortresses by day, roar out to hammer Axis factories and railroads, their crews know exactly where their targets are and what they look like, regardless of camouflage, because they have studied actual photographs of them—snapped and smuggled out by the Underground. When European patriots exterminate a prominent Nazi, their secret newspapers carry pictures of the dead Hun. Despite every attempt to confiscate cameras and films, despite the death penalty for possessing photographic equipment, the work goes on. How? MI will bring you the story in The Eye of the Underground, in the December issue. Don't miss it!

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BOY! IT DIDN'T TAKE ATLAS LONG TO DO THIS FOR ME! WHAT MUSCLES! THAT BULLY WON'T SHOVE ME AROUND AGAIN!
LATER
WHAT! YOU HERE AGAIN? HERE'S SOMETHING I OWE YOU!
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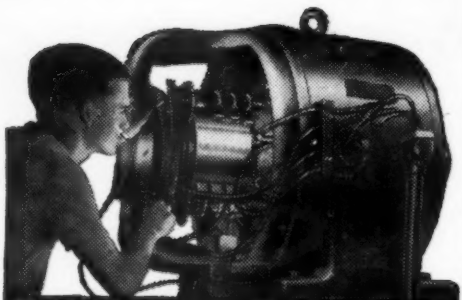

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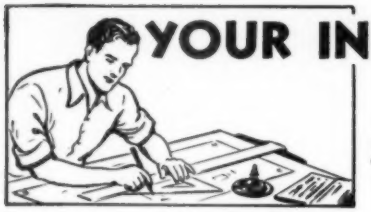


YOUR INVENTION CLINIC

Conducted by

JOSEPH H. KRAUS

Mr. Kraus has been giving advice to inventors for more than 20 years. He will attempt to answer as many letters from inventors as possible in his column each month. Mr. Kraus will "call his shots as he sees them" in this column. Thoroughly versed on inventions and inventions procedure, he will never, under any circumstances, disclose any valuable secrets. He cannot answer questions relating to patent law. For such information, the Editors suggest you communicate with any one of the patent attorneys who advertise in MECHANIX ILLUSTRATED.

Airplane Skin Fastener

L. J. Jires, Baltimore, Md., states that he has an idea for fastening blank aircraft fairing skins for predrilling. He states that the device is similar to another fastener and wonders if it could be patented.

ANSWER: *This seems valuable. Only a search would reveal if it appears patentable. But it should be tested now; and if found superior to anything else it should be put into operation immediately without regard to patent status. Any personal gain should be subservient to winning the war on the battle and production front.*

There are two courses of action we would recommend. First, communicate with an official of the company manufacturing the present style of clamp. Tell him that you have designed a modification of his company's clamp which permits of its much wider use. Make these declarations in writing.

Second, speak to your foreman. Ask him to go with you to present your plan to officials of your present company. Let your present employer worry about the patent status—if any.

Maybe you'll get only glory for your efforts. Perhaps a promotion. But what is more important —you may save many lives. Against this dollars don't count!

U. V. Sterilizer

A. Greenberg, New York, N. Y., has an idea for using an ultra-violet lamp in a home refrigerator.

ANSWER: *Sorry, you're too late! Westinghouse has had and demonstrated a similar lamp for many years.*

Fuel Storage

Staff Sergeant R. H. Poggensee, Sheppard Field, Texas, has designed what he calls a safe storage for fuel in the combat zone.

ANSWER: *Locating fuel under a body of water is only reasonably safe. This general position has had considerable use, even for food. Unfortunately, it entails much handling and is hard to get at.*

Your design is unique but expensive. It is not as safe as you imagine it to be. It would be more simple to roll drums of fuel into the water and pull them out again for use when needed.

In as much as your design is applicable only for "hot" war areas its adoption would be limited if this were the only reason. But, your storage containers take up a lot of room during transportation. This space could be used for more vital fuel, food, ammunition and guns. For these reasons we feel that the present plan will not get a favorable report.

As a post-war effort, your plan is useless. By the way, the material from which your proposed tank is to be made is the worst you could select for gasoline storage.

Enlarger Cooler

Paul A. Wolf, New York, N. Y., submits a design of a photo enlarger with a film cooling system.

ANSWER: *Your system is an elaboration of the ordinary water cell as applied to a vertical enlarger. It has no advantages over that cell. On the contrary, its water-enveloped bulb exposes the unit to danger of a short circuit and positively insures that there will be a corrosion of parts. There will be a production of water vapor which on condensation might damage film and other metal parts.*

We emphatically advise against any effort with water cells made as this one is designed. Photographers who do not have well ventilated enlargers can always use cold fluorescent light.

In the Bag

S. L. Heaps, Kewanee, Ill., writes in this mysterious fashion: "Have followed 'Your Invention Clinic' for some time, and feel that you render an outstanding service to a lot of cranks—or nuts, as you prefer.

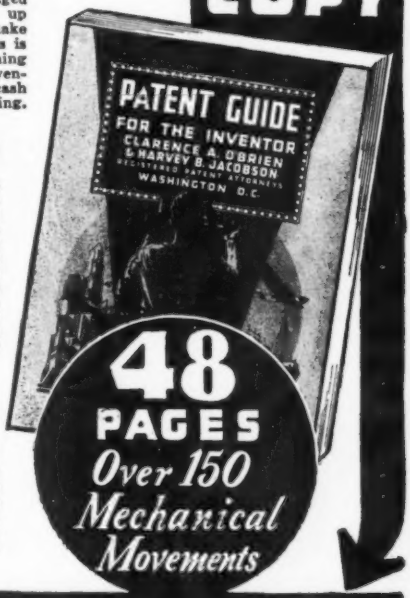
"My query is this: My idea is not precisely an invention, being rather a new adaptation of an article in common use. It can be made up cheaply of non-strategic materials, even of wood, and once used (as is proven by experience), is in great demand. My understanding is that it is not patentable. Question: How can I realize on it, say on a royalty basis?"

[*Continued on page* 150]

INVENTORS Get FREE COPY

NOW Is the Time to PATENT and SELL Your Invention

Now, more than ever before, is the right time to patent your invention. Why? Because manufacturers everywhere presently engaged in war production are looking ahead to the future by buying up patent rights now, so they will have new and attractive items to make and sell for civilian consumption as soon as the war is over. This is what happened during and after the last war. Hence, the smart thing for you to do is to look ahead to the future too. Protect your invention by applying for a patent now, so you will be in position to cash in on an outright sale, or on the royalties your invention will bring.



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CHIPS FROM THE EDITOR'S WORKBENCH

Arch Whitehouse

Will Oursler

With Pride

IT IS with considerable pride that MECHANIX ILLUSTRATED announces the fact that two of America's outstanding writers have accepted assignments to cover the European and the Pacific War Theaters as accredited War Correspondents for this magazine.

MECHANIX ILLUSTRATED now becomes the only magazine in its field with accredited correspondents at the actual fighting front in both theaters of war, to bring you the very latest first-hand information of the progress of science in battle.

Mr. Arch Whitehouse, one of the best known names among American authors, is about to take off at this writing to represent MI in the European Theater.

Mr. Will Oursler, well known young writer and radio commentator, is already in the South Pacific for MI and his first story from that area will be found on page 35 of this issue. Mr. Oursler left New York intending to ask for an assignment with a task force. Since big things are now breaking in that section of the global war front, you can expect some thrilling dispatches from him in the near future.

Mr. Whitehouse held a commission in the Royal Flying Corps in the last war and is officially credited with downing 16 enemy planes and six balloons. Since the end of the last war, he has written more than 10,000,000 words, principally on the subject of aerial warfare. Few persons in the world have the background he possesses as an expert on this subject. He has been consulted by Army and Navy experts on the subject of air gunnery design and practice (see his article, "How the Navy Trains Aerial Gunners," on page 42 of this issue) and has received official invitations from both the British and the U. S. Navy to view training and action on land and at sea. Not long ago, he made a tour of inspection of the U. S. North Atlantic Fleet by invitation.

Mr. Whitehouse has been a frequent contributor to such magazines as Readers Digest and The Saturday Evening Post. One of his serials published in the latter magazine was made into a hit movie, Spitfire Squadron, by 20th Century-Fox. Mr. Whitehouse's works include two major books on military aviation.

Mr. Oursler, considerably younger than Mr. Whitehouse, has made an enviable name for himself as a writer. A graduate of Collegiate School in New York and of Harvard ('37), he served a four-year apprenticeship on the Hearst Newspapers and has since been published in such magazines as American Mercury, Liberty, Your Life, and a number of others. He has also written successful mystery novels, such as Trial of Vincent Doon and Folio on Florence White, both for Simon & Schuster. He held two editorial positions briefly, before deciding he wanted to smell powder for MI.

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WIN THE WAR AT HOME

BY W. H. FAWCETT, JR.

PRESIDENT OF MECHANIX ILLUSTRATED

AN INTERESTING document came across my desk recently—one that everyone in this wartime America might be willing to mull over. It's called a Pledge To Win the Peace, and is drawn up by the Writers' War Board, a semi-official organization composed of a great number of America's leading authors and commentators. Two of the most active of these are Margaret Leech and John P. Marquand, both Pulitzer Prizewinners; others are Clifton Fadiman, William L. Shirer, Russel Crouse, one of the authors of Life With Father, and Oscar Hammerstein, II, the famous musical comedy writer.

At any rate, the following Pledge is from the Writers' War Board, and we're passing it along for your serious attention.

—★—

A PLEDGE TO WIN THE PEACE

I am a citizen of a great country created 160 years ago by the union of thirteen divided and quarreling colonies. Now, to save us all from future wars such as the one in which we are engaged, the time has come for all the countries of the world to get together in the same way. I therefore favor the following ideas:

1. We must see to it that the Germans and Japanese are defeated in such a way that they can never again start another war.

2. A world-organization should be formed, which would not in any way interfere with my being an American.

3. At first it should be made up of the United Nations and any neutral countries that the United Nations may want to admit.

4. But Germany, Japan and their allies may not be admitted until they show that they can be trusted.

5. Just as no one of the United States may leave the American Union, so no member may at any time leave the world-organization, or Union of Nations.

6. Just as Pennsylvania may not declare war on California, so each member of the world-organization will have to give up forever the right to commit any act of war against any other member.

7. Just as we have a police force and a National Guard to keep order, so the world-organization will have a police force operating all over the world for the same purpose.

8. This world-organization should declare itself against the idea of any nation ruling any other, and so should gradually rid the world of any such system—thus making freedom a universal right.

I believe in these eight points because I do not want my brothers, husband, children in still another war. After this one is won, I believe that peace will be permanent only when all of us act together to make it so. Supporting these points is my idea of the first step toward this.

—★—

There is the Pledge to Win the Peace as projected by some of the nation's foremost writers and thinkers. What do you think of it? Have you any suggestions or comments to make? Would you like to know more about it? If so, just drop a postcard to The Writers' War Board, 122 East 42 St., New York 17, N. Y.

—★—

Now that cold weather is just around the corner, so to speak, people who live in private homes should check with local officials to learn what modifications have been made in fuel rationing rules for this winter. You may find that you can get more fuel than was allotted to you last winter.

A recent announcement by the OPA stated that certain small private homes which are below average in heating efficiency because of poor construction, will be allowed proportionately higher rations. This also will be the case with very large residences which are difficult to heat although due allowance will be made for closing off unused parts of the house.

Officials state that only a small percentage of illnesses were reported last winter due to the fuel rationing. Keep in mind that in bona fide cases of illness a physician certifies to the necessity for extra rations, and they are obtainable from your local ration board. This is very important because illness cuts down our manpower, so essential to winning the war.

W. H. Fawcett, Jr.

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DEATH MISSED FOUR TIMES

by Will Oursler

MECHANIX ILLUSTRATED *War Correspondent in the Pacific*

ABOARD a transport in the South Pacific (Delayed)—Death clutched four times for Lieutenant Donald S. Bloch—and four times missed.

He told me about it himself—the first part of it, at least—one night on deck of our blacked-out ship, creeping toward an island destination.

You wouldn't think of Don as the kind who likes to play tag with destiny. A couple of years ago, he worked in the shipping department of a Boston office. He isn't, as he puts it, adventurous.

To look at him—short, sandy-haired, with oversize nose and square chin—you'd think of all the kids you see in America, boys taking girls to movies, fellows working during the day and looking forward to dates and hot-dogs at night.

I'd heard he had been on one of the early raids on Wake. Sure, he remembered. "That raid got a play in the papers back home. Didn't mean so much though to me personally, you understand. Not half as much as a raid you never heard about."

His voice came through the darkness of the deck. "It was our first time, you understand. Our first time into real action.

"How did I feel? Hell, I was apprehensive—yes, say apprehensive. But I was eager, too, in a way. At least I and the rest of the crew of the ship—it's a B-24—at least we'd find out what it was like.

"We took off around dawn, flying in elements of three. Before we started, I was thinking about my family. But once we took off I was too busy to think. See, I'm not the pilot but the co-pilot, and I have the job of checking on everything.

Lieutenant Donald S. Bloch and his bride.

"Nothing unusual about the first part of that flight. Over water, with chalky clouds under us most of the time. We had a factory to knock out on the Jap island of Nauru. We had two waves of planes, you understand. The first would go in and drop its load on special targets. Then the second would come in and finish up. Nauru's like a long finger in the water. Never more than a few hundred yards wide. Jungle growth in the middle of it.

"Sure I was scared. But at least our B-24 crew was going to find out what it was like."

"Anyway, the time came when we took off. Sure I was nervous. I had butterflies in the gut. When I climbed into the plane I gave my ring to the mechanic. Told him to keep it till I got back. Otherwise—he had an address back home.

"We sighted the target. Every man was at his battle station and the ships began to range into battle formation.

"We were flying on the right flank of the first plane. As we came into the island, I looked down through my glasses but couldn't see any signs of activity below. No antiaircraft fires as we came near either.

"Then we spotted three Zeros about twenty miles in front. That was my first sight of a Zero. We were weaving as we came in over the target but there was still no antiaircraft.

"We made a dry run the first time over the target. By the time we circled round to go over again, other ships had come in and dropped their sticks and I saw a hit had been made on a gasoline storage depot near the airfield runway below. Big black fumes rolling up.

"On a flight like that, everything happens quickly, almost mechanically. We dropped our stick of bombs on the airfield and started off. We knew we'd hit our target—we learned later that the other formation which followed us demolished the factory.

"But now antiaircraft was starting. Pretty puffs of smoke all around us. You'd look at them and sort of admire them. You couldn't think of them as death.

"We got into tight formation as we flew out of the flank. I remember thinking this was all like something I'd seen in the movies. I felt like I was playing a part in a movie and watching at the same time.

"The Zeros were all around us now and our machine guns were fighting them off. Their idea was to break up our formation. Our idea was to stick together. One Zero dove in from the stern but slipped off when the machine guns started making it too hot. I had been glancing off to watch that one when I heard someone call out a warning behind me.

"There was too much

Continued

Death Missed Four Times

damn racket to hear what he said but I knew he was trying to yell to the nose gunner and I looked ahead. Hell, a Zero was diving on our nose, guns blazing straight at us. I could see machine guns and a cannon firing point blank.

"I reached toward the pilot and we both ducked. Ducking wouldn't have helped, it was just instinct. The Jap was so close you could almost feel the heat of his fire.

"I wasn't actually thinking—just expecting the ship to be hit. The Jap had a dead bead on us. But something happened. The Jap missed. I looked around. Somebody yelled, 'He missed. The ——— yellow bastard missed!'

"About seven of those Zeros followed us for more than an hour. They were still trying to break us up but our guns kept them off. One plane had been hit and its rudder was nearly shot off. It was limping behind, so the rest of the ships swung around in a big circle and brought the plane into the group, giving it protection.

"After awhile the Zeros gave up and went home. We got back to our base all right, no planes missing but a few of them shot up a bit.

"Getting to earth again was good. The mechanic gave me back my ring. He said he had been rubbing it all day.

"For a couple of hours after landing, I was too excited to feel much. Then, walking toward the tent where I'd be sleeping, I suddenly realized how close to death we'd been. Those puffs of smoke were death. And the Jap plane on our nose—it should have blown us to bits. Death missed by an eyelash that time. Now when it was over—my knees were shaking.

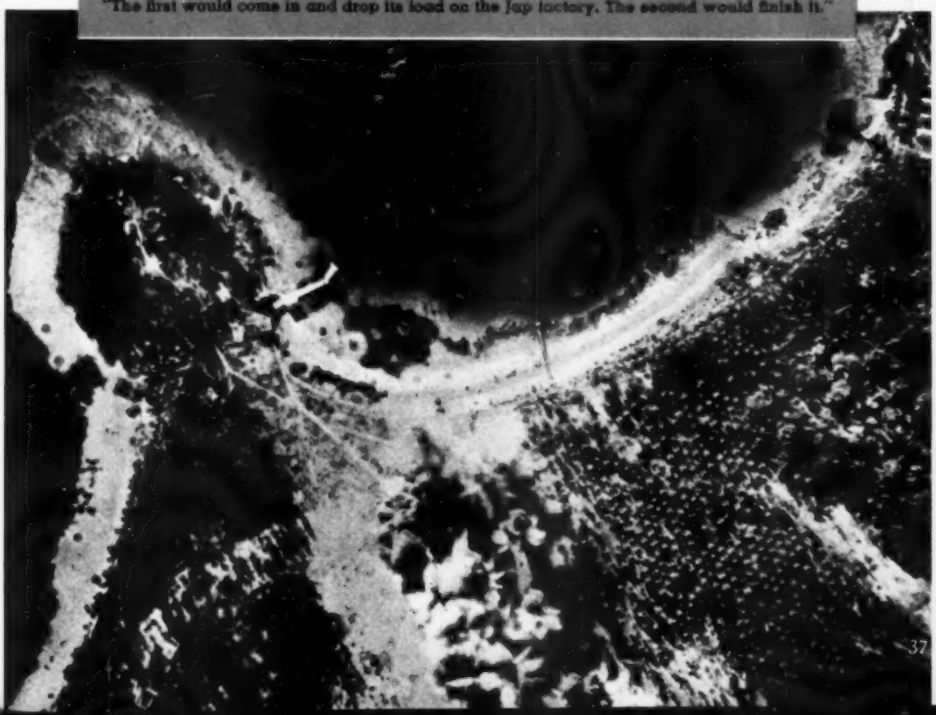
"We kept kidding some of the men on the island. Told them that after our little job on Nauru, the Japs would strike back and probably make it pretty hot. By that time, we'd be on our way home. The fellows said they wouldn't mind, it had been too damn peaceful anyway.

"A couple of nights after we got to the base, I woke up about two in the morning. It was raining. I could hear the rain on the canvas. I lay there in the darkness. It was a hell of a long way from Boston.

"I don't know just what time it was but I heard a siren. Lt. Ernie Moore, our bombardier, was in the next cot. He woke up and sat up in bed. 'What the devil is that?' he asked.

"I said it sounded like an air raid. Then I did a double take. Hell, an air raid. That was what it was. Ernie said maybe it was a test. I said maybe [*Continued on page* 141]

"The first would come in and drop its load on the Jap factory. The second would finish it."



"PHOOEY ON RATION POINTS"

How'd you like to tear up your ration book and feed on the fat of the land? Here's the man who can teach you how to do it.

by Louis Hochman

DOES your stomach growl from hunger? Are you thin, nervous, and losing weight? Does the high cost of living keep your cupboard bare? Have you got those ration point blues?

If any of these symptoms are getting you down, there's a man in Suffern, N. Y., who can show you how to laugh at ration books while sinking your teeth into a thick, juicy steak and coaxing it down with generous helpings of a variety of canned and fresh vegetables. He can show you how to live

Folks pay for the privilege of working in garden at Ralph Templin's school of sufficiency.

It's a mighty comfortable feeling to have a smokehouse filled to top with cured hams.

An electric butter churn, operated in partnership with a cow, sneers at ration points.

Small flour grinder in your home keeps you supplied with something to go with butter.

off the fat of the land, build and furnish your own home, raise your own livestock and vegetables and even make your own clothes from material you weave yourself. In short, he can show you how to be entirely self-sufficient, dependent on none but yourself for the food and lodging you enjoy—and all this at a cost far below the average city dweller's expenses.

His name is Ralph Templin and, with his wife, he heads a novel School of Living where thousands of people including businessmen, artists, teachers, social workers, and college students have come over a period of years to study his course. To the casual observer, the School of Living looks like an ordinary four-acre farm, but a closer inspection will reveal such unusual apparatus as large hand looms, a small flour grinder, an electric cream separator and butter churn, and a fully equipped workshop. Mr. Templin believes that if he can get city folks into the country, they can learn to become self-sufficient on small farms run by hand and electrical modern

Students at Templin school weave their own rugs on hand looms.

gadgets and thereby easily double their living standards without back-breaking toil.

Students come from far and wide, often by the power of the thumb, and pitch into the daily routine with keen interest and enthusiasm. There are no organized classes at the School of Living. The students learn in a natural manner by actually living the experience. They help in the garden, milk the cow, repair the barn, build composts for fertilizer, can vegetables, grind flour, weave cloth and rugs, and cure and smoke meats. Often they take over the kitchen and prepare the evening meals themselves, and all share in the work of setting the table, serving, and cleaning up. Mr. Templin holds daily discussions, and instructs the group on the economics of homesteading and advises them on correct procedures to follow in establishing themselves on their own land.

Many couples come as guests purely out of curiosity—soon find a new interest in making things grow, and before they realize it, they've bought their own pieces of land and gone in for homesteading in a big way. One such couple, neighbors of the Templins, came out with a very skeptical attitude. They had a small boy who had never been out of the city limits and knew nothing of farm life. The man took a keen interest in homesteading and, contrary to his wife's wishes, bought a small farm near by. Gradually, his wife began to take interest and spent more and more time in the garden. The boy also pitched in with vigor and soon asked for his own little garden, which he now tends lovingly along with his other duties as chief goat keeper.

Many professional people, who have dared to break away from the big city, are now enthusiastic homesteaders. They find that they can continue their professions while living cheaply off the land. One such person, a New York tea importer, moved out to a small town, bought a small farm, and converted a large barn into a warehouse. At first the shift cost him 50 per cent of his trade, but the difference in overhead enabled him to realize a greater profit from his 50 per cent than he could with his full trade in New York. "Why should I care," he said, "when I can profit more from doing half the work?"

The School of Living belongs to a Co-operative Society, a community group composed of sixteen families who work together, sharing the problems and resources of one another. The Co-operative Buying Club in one of the houses serves as a center where the members exchange the surplus produce which they have raised and processed. They hold regular meetings and discuss improvements and needed equipment and machinery. Often, several families [*Continued on page* 143]

Graduate of Templin course lights cigarette with points!

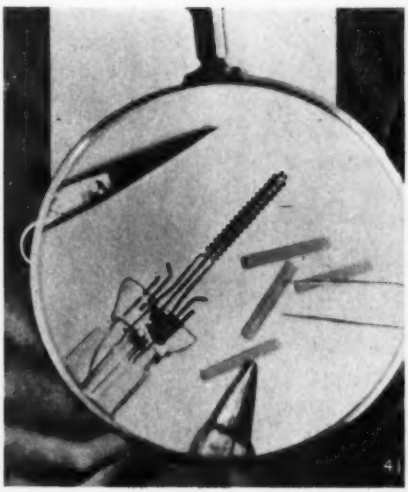
IDEAS THAT WIN

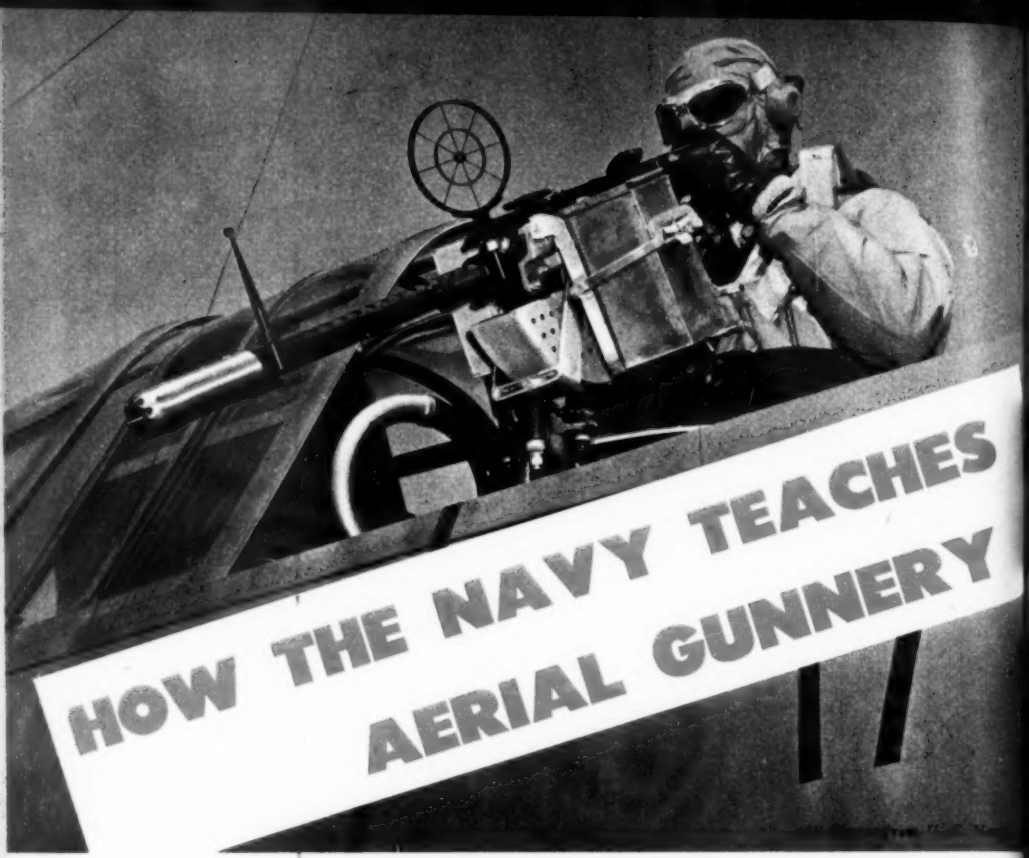
A PIECE of spaghetti, a knot in a length of string, a hypodermic for airplanes—these are the things winning the war for America. For the one quality that distinguishes the American mind from that of the Nazi is its ability to *improvise;* Americans have the mind of the handyman, who turns bits of junk, odds and ends, bizarre materials into powerful tools. On this page are a few samples of such American ingenuity—found in factories all over the land.

It's difficult to push a piano wire through a twisted conduit in wiring airplane stabilizers. Russell Dudly, Fisher Body worker, knots a string, blows it through with an air hose, then pulls the wiring through.

Aleho Garcia, of Consolidated, squirts glue from a hypodermic into a blister under cloth on an aileron. Formerly cloth had to be pulled off and reglued.

Formerly, steel was used to hold a radio filament while welding. But steel often stuck. William Hayes, of Westinghouse, substituted a piece of spaghetti!





HOW THE NAVY TEACHES AERIAL GUNNERY

America's lop-sided score of aerial victories is principally due to the superb gunners coming out of our training centers. Above: The U. S. three-ring gunsight.

by Arch Whitehouse

IN THE last war an airman who shot down five enemy planes automatically became one of the unofficial heroes called Aces by the imaginative war correspondents. About 80 per cent of the decorations awarded airmen in World War I came as a reward for success in defeating enemy Fokkers, Albatri, Gothas or sausage balloons.

Today, no one brags about the number of planes he has shot down. A man with five to his credit feels that he is just emerging from the bush leagues of military aviation. He just won't talk about shooting down a mere five, but he'll rant on for hours about the number of operational patrols he has completed.

There's the difference between World War I and World War II.

I have just returned from a comprehensive inspection of a number of U. S. Navy air training centers where I was able to see for myself just what makes the Navy fliers tops in the box score against enemy airmen. I covered nearly 3,000 miles to follow up kids who entered boot camps to emerge eventually either with the gold wings of the Navy on their breasts or the equally hard-to-get sleeve insignia of the Aviation Machinist's Mate. What I saw left me gasping. When I climbed down from the Navy transport in New York and someone asked me what I thought of it, all I could say was: "We can thank our lucky stars that these guys are on *our* side."

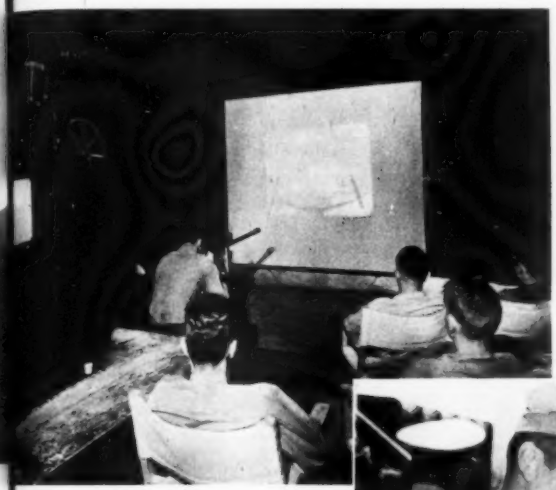
It would be simple to explain it by saying: "Well, after all, they're Americans, aren't they?" and trust that would cover the matter, but it goes deeper than that.

In the Navy they really train 'em!

As a former air gunner in the early days of World War I, I was naturally interested in the methods used today as compared to the

"instruction" I received before going into the air against the enemy.

Late in 1916, when I had tired of mud and trenches, I put in an application to transfer to the old Royal Flying Corps, the British Army air service of that day. Eventually, because I was a trained machine gunner, my application was accepted and early one Saturday morning I left my outfit where they were dug in near Arras and hopped lorries to a back area. By noon time I reported at No. 22 Squadron, where they were flying old F.E. 2b pusher types on Corps operations. By 2 o'colck that same afternoon, I had been taken into the air, flown over a small patch of fabric staked out on the ground and had somehow fired a few shots into it. Regardless of the fact that I had never been in the air before, I was immediately put down on squadron strength as an aerial gunner.



The familiar penny arcade shooting gallery machine, greatly improved, aids our training of aerial gunners.

At 3 o'clock the same afternoon I was taken on my first offensive patrol. That gilded wench Lady Luck took me in hand and I shot down a Hun, much to the pleasure of several officer observers who were awaiting replacements so that they could go back to England and take pilot training.

Mark you, mine was not an exceptional case. There were hundreds of youngsters like myself who volunteered from the trenches and somehow made history for the old R.F.C. But compared to what I saw recently, none of us had any right on an air field, let alone going on an offensive patrol.

You might be interested to know that an aerial gunner in the United States Naval Air Service gets no less than 656 hours of intensive ground instruction before he ever joins the Fleet. In other words, he gets more basic instruction time in than I put in as an aerial gunner over the enemy lines before I became a pilot!

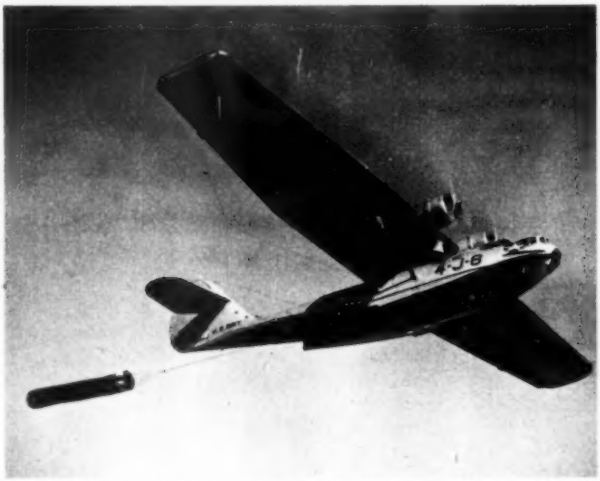
In many cases the air gunners in the U. S. Navy get over 600 hours of first-class ground instruction in all types of aircraft armament before they even fire a shot in practice. They may get impatient and grumble about getting into action, but not one of them will ever be justified in claiming he was not fully trained. There's one point the mothers and fathers of this nation can pin their faith on. Their sons won't ever be sent against the enemy without the finest training course in the world at their fingertips.

A mobile Navy training unit used for instruction in the 20 mm. gun. The multiple ring sight, used for leading planes, can be seen again here. Arch Whitehouse, before leaving for Europe as MI's War Correspondent, is seen here at a 30 caliber gun as he gathered material for this article.

The physical requirements are as stiff as those drawn up for the Cadets who gain appointments to become pilots, but for air gunners the Navy prefers men on the smallish side and preferably under 160 pounds. The

confined space in the modern gun turret makes this imperative. If you are a six-footer and show decided aptitude for the work, however, you may be retained as an air gunner and your training will be slanted to the PBY types where there is plenty of room in the waist blisters. To sum up the physical requirements: the Navy will be more than fair if you have the stuff. As new and larger flying boats of the winged battleship category are completed and sent to the Fleet, the requirements will be changed to meet the conditions.

At the Naval Air Training Center commanded by Captain M. E. Browder, U.S.N., in Chicago, candidates get their first close-up of Naval air ordnance, their first chance actually to touch and study .30 and .50 caliber machine guns and 20 mm. air cannon. Here too, they are introduced to several types of power turrets now in use in Navy multi-place planes. They learn the mechanism of these turrets, how to test, check and repair the hydraulic systems and they become fully acquainted with turret installation. Outside this massive building we saw hundreds of young seamen learning to mount machine guns in the wings of fighter aircraft, servicing the gun turrets under actual hangar conditions and checking the bomb racks, release equipment and the selector gear which automatically releases the bombs in predetermined sequence. Here they learn how to set the Mickey Mouse gear to drop bombs along railroad tracks in precise timing, or how they can be released in twos or threes or in complete salvos.



Streaming a target from a plane is the Ordnanceman's job—and a ticklish one, too, for any false movement may result in towline snapping.

At this point the students are simply learning the mechanical side of the work. Later they may volunteer for actual aerial gunnery. No one is compelled to become an aerial gunner. But it goes without saying that the number of volunteers more than equals normal requirements.

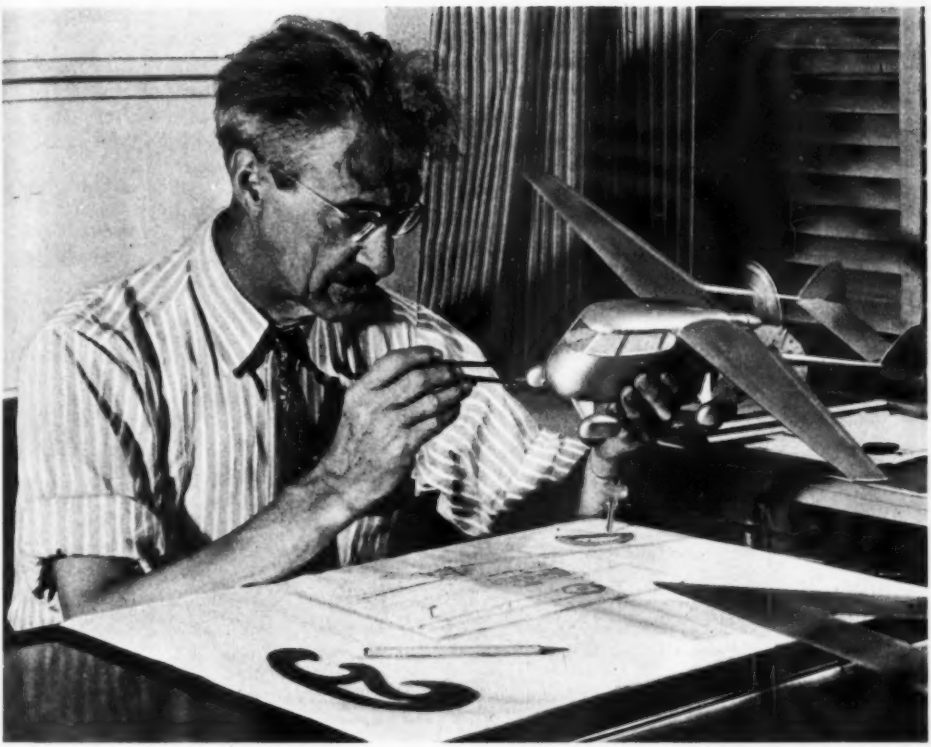
Once a student has learned how to service the ordnance on many types of first-line planes; once he has learned how to arm a bomb, hang it correctly in the rack, adjust the selector gear in the bombardier's compartment and has shown he can service and install all types of machine guns he is ready for his examination to become an air gunner.

Remember, he already has put in 656 hours of actual school work on the ground and has registered 144 additional hours of physical training which includes Commando and voluntary recreational sports so that by now he is what the Navy calls "rugged, vigorous and agile." He is ready to take up further ground instruction at a training center such as we visited at Norman, Okla.

The first thing a prospective air gunner learns at Norman is that until he can recognize at least twenty enemy aircraft, he isn't fit for gunnery, regardless of the marks he may have piled up in the shops. Sitting in the recognition room, it suddenly came to me that when I went into the air that bewildering Saturday back in 1916, I couldn't tell a Handley-Page from a Fokker monoplane and that I just fired at anything that had a black cross on it. In comparison, I saw a class of seamen students sitting before a projector that was throwing pictures on a screen through a timing device that allowed them to see the picture for 1/75th of a second—and scoring an average of 93.7 in their examinations!

Have you any idea how long 1/75th of a second is? It's just as long as it takes you to say "Blip" and no longer. Most of us who *think* we know something about modern military aviation will study a photograph of a Jap Zero for several minutes before we will commit ourselves [*Continued on page* 154]

WILLIAM B. STOUT AND HIS WONDERFUL "SKYCAR"

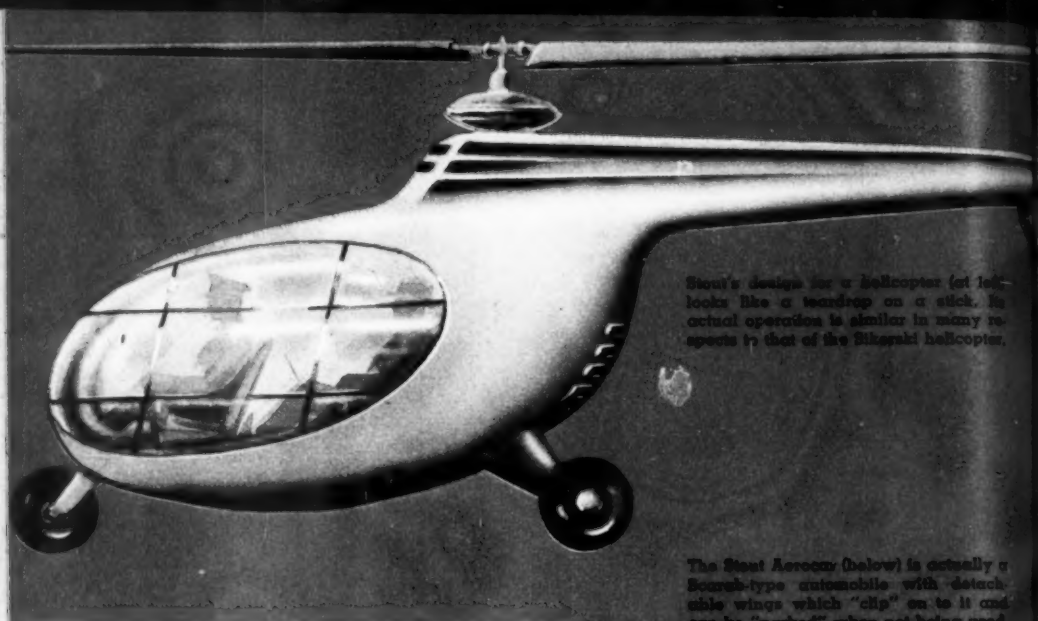


Genius at work: Bill Stout working on a model of his "Aerocar," an automobile with detachable wings, which he is designing for Consolidated-Vultee Aircraft for post-war manufacture.

by J. A. Greenberg

BILL STOUT, the genius of Dearborn, Michigan, has been responsible for more revolutionary innovations in the design and construction of automobiles and airplanes than has any other man, living or dead. Yet he has found time to create such minor novelties as the first gasoline-driven railroad car, the first Diesel-electric streamlined train, a streamlined motorbus lighter and faster than any then manufactured, a brick conveyor which saved thousands of dollars in building construction, an improved theater seat, an air-conditioned bed, and, among other things, a staggering number of mechanical toys. He has been credited with more technical inventions than any man since Edison.

Now Bill Stout is in the news again, making the "experts" sneer and popping the eyes of the public. This time he has designed an "Aerocar" and a "Helibus" for Consolidated-Vultee Aircraft Corp. (see illustrations on next page). The Aerocar is an automobile with detachable wings which can be "parked" in the garage or at the airport when the Aerocar is being used on the road. Many technical noses will be lifted at Stout's design—but in the end, you can bet, we will all be riding in some contraption very similar to



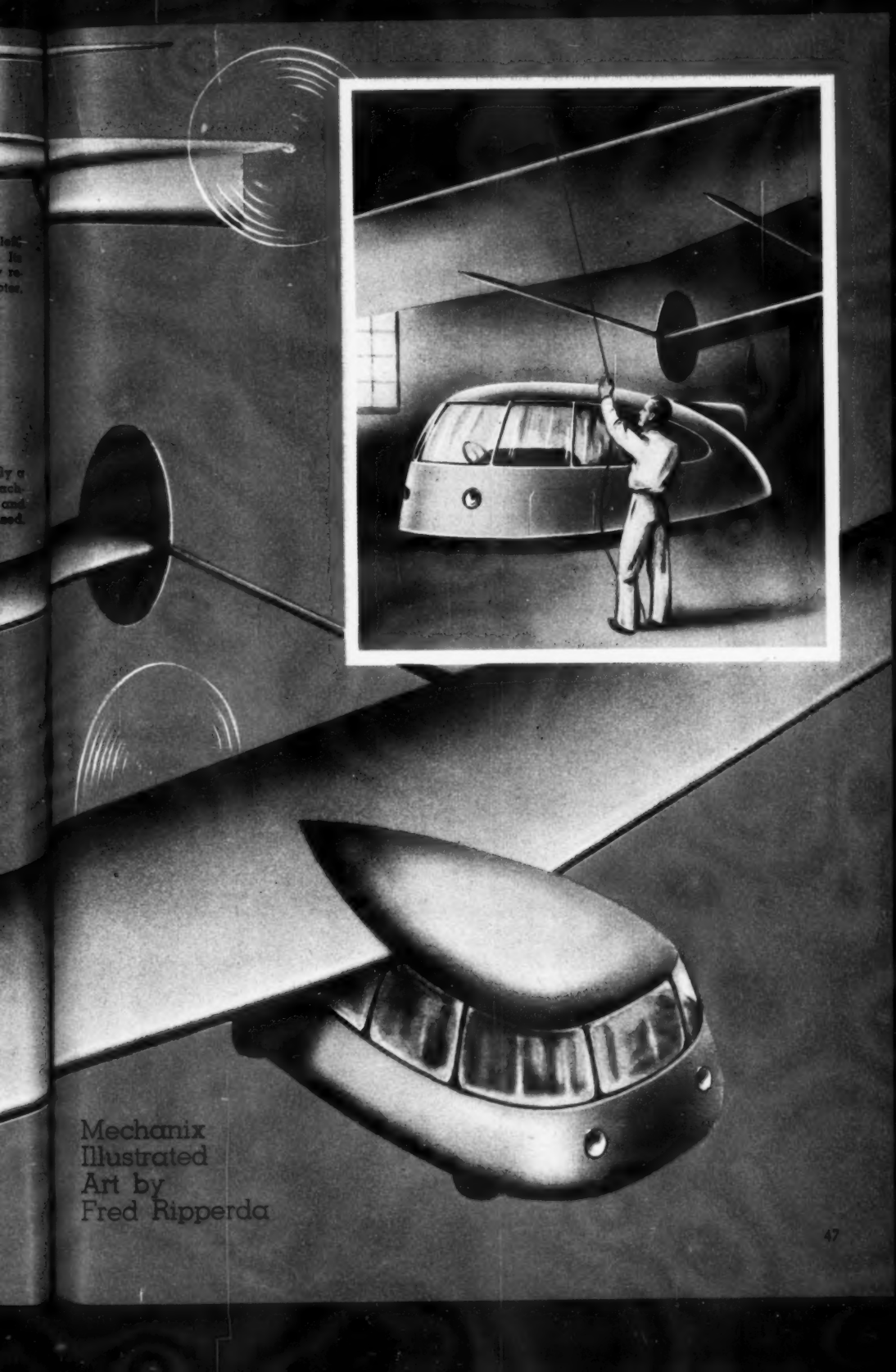
Stout's design for a helicopter (at left) looks like a teardrop on a stick. Its actual operation is similar in many respects to that of the Sikorski helicopter.

The Stout Aerocar (below) is actually a Scarab-type automobile with detachable wings which "clip" on to it and can be "parked" when not being used.

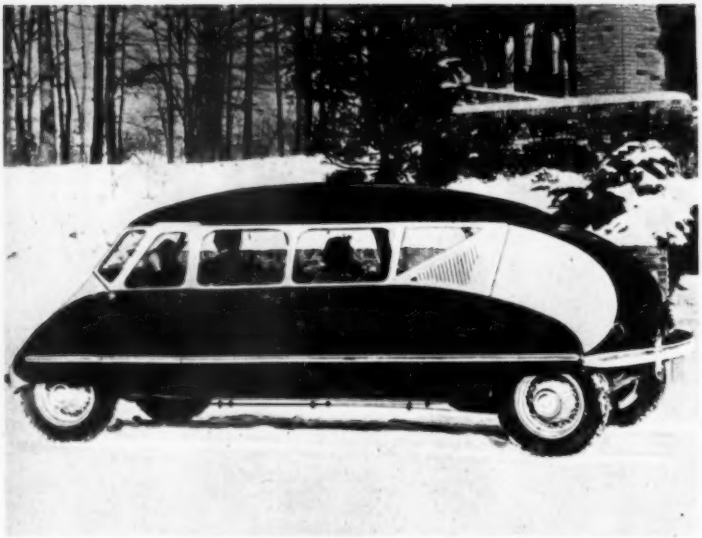
it. For all of Bill Stout's inventions follow the same routine: 1. Derision by the "experts," and, 2. Final adoption for general use a few years later.

A character and a legend in the automotive and airplane industries, he has been conducting a crusade against adherence to tradition and the formulae of the past since he graduated from the University of Minnesota thirty-five years ago. From all of which it may be gathered that Bill Stout has no overweening fondness for professorial conclusions. "Never resort to mathematics," he once said, "until you have exhausted the possibilities of two toothpicks and a piece of string." The key to his technique is disclosed by a motto prominently displayed on the wall of his drafting room: "SIMPLICATE AND ADD MORE LIGHTNESS."

Called "industry's most whimsical and unpredictable inventor" (an appellation he does not like), he is amiable, informal and easy-going, always smiling and completely free from affectation. His figure is sparse and not too strong-looking, his features lean and bony, with a thin mustache and a wild thatch of hair through which he is continually running nervous fingers. He bears a striking resemblance to Fritz Kreisler, the eminent violinist, though there is a whimsical reminder of Groucho Marx in his mouth and eyes. Characteristically midwestern and homespun, he is voluble and restless, never in a hurry and ready at any time to indulge a cracker-barrel



Mechanix
Illustrated
Art by
Fred Ripperda



One of Stout's more startling designs was the Scarab automobile, a teardrop car with engine in rear. Most of its more radical features have been adopted.

fondness for conversation. He will talk for hours, to tycoon or laborer, on every conceivable subject, throwing off ideas with prodigal abandon.

William Bushnell Stout, to use his full handle, was born in Quincy, Ill., on March 16, 1880, where his father, a semi-itinerant Methodist preacher, was temporarily anchored in the service of God. He was a frail, scrawny child, whose frequent illnesses caused despair for his survival to manhood. Still, when a critical childhood ailment laid low both Bill and his twin sister, it was the plump, husky little girl who died.

The sickly boy could not take part in the strenuous games of other children. Of all things, he wanted most to play ball with the boys, but his eyes were so bad that, as he tells it, he "couldn't catch a balloon with handles on it."

This early frustration drove him to making things with his hands. Wherever, in their frequent wandering, his father occupied a pulpit, Bill set up a crude workshop and embarked upon multitudinous projects, most of which remained unfinished. Thus began his experimentation with two toothpicks and a piece of string.

At high school Bill found his studies hard and the discipline irksome, but this trouble was happily solved by his transfer to the Mechanical Arts High School in St. Louis, where "Jack Knife" could pursue his already developed talent for tinkering.

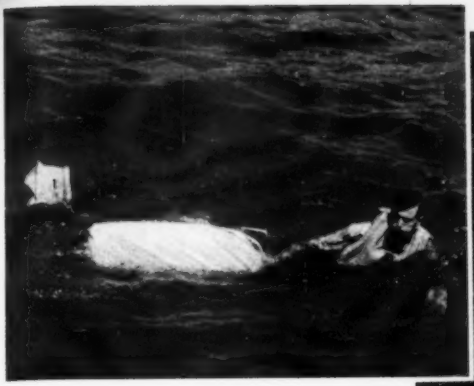
Unhappy at Hamline University, where he first matriculated, Bill moved on to the University of Minnesota. With parental assistance difficult and unlikely, he was forced to support himself by running a laundry (an unsuccessful venture), by waiting on table, by teaching manual training, and by whatever other opportunities presented themselves. Once, when tending furnace for his board, he found it so unpleasant to run down five flights before dawn in the Minnesota winter that he rigged up a contraption of cords and pulley attached to the key of his alarm clock. Thus his laziness mothered the invention of one of the earliest heat-regulating devices.

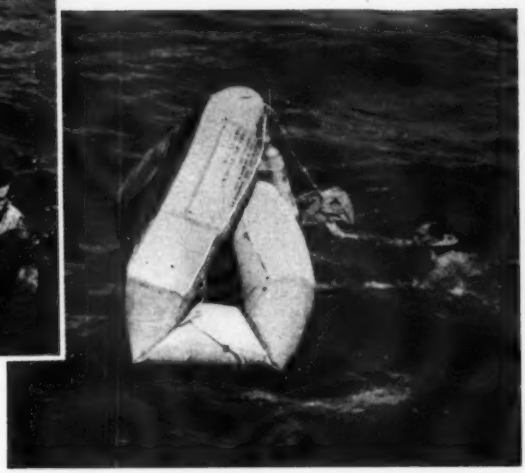
About this time he began to write about the mechanical toys which he had been making since early boyhood. His first article, sent to Harper's Young People, brought a prompt reply, a check for $12 and a request for more of the same. Spurred by this munificent sum, which paid for more than two weeks' sustenance, he cudgeled his brain for creations to write about. Eventually, it brought in enough money to put him through college comfortably.

By 1906, when he married Alma E. Raymond, he was writing a syndicated column for the St. Paul Dispatch. The advertising department got him a motorcycle on a due bill, but this machine was so bad that Stout designed his own with many improvements, not the least of which was a better engine. He probably had the first engine with two-speed gear on a motorcycle. Eventually he became an authority on the internal combustion engine.

His articles on aviation brought an offer from the Chicago Tribune to become aviation editor. He started a magazine called Aerial Age, organized a model-plane club for boys, and contributed to two magazines concerned with automobiles, until Dave Becroft, editor of Motor Age, induced him to join the staff on a full-time basis.

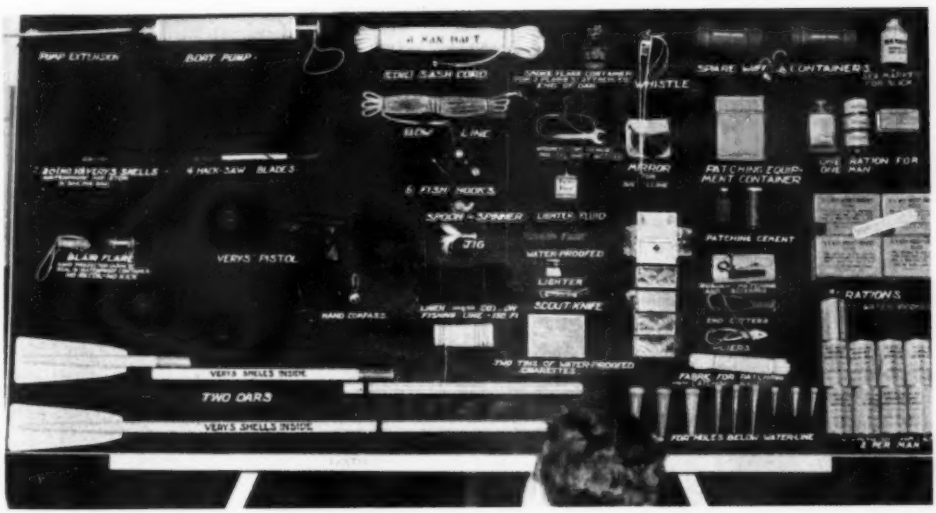
Aviation was pulling Stout like a magnet. Two years later he [*Continued on page* 145]





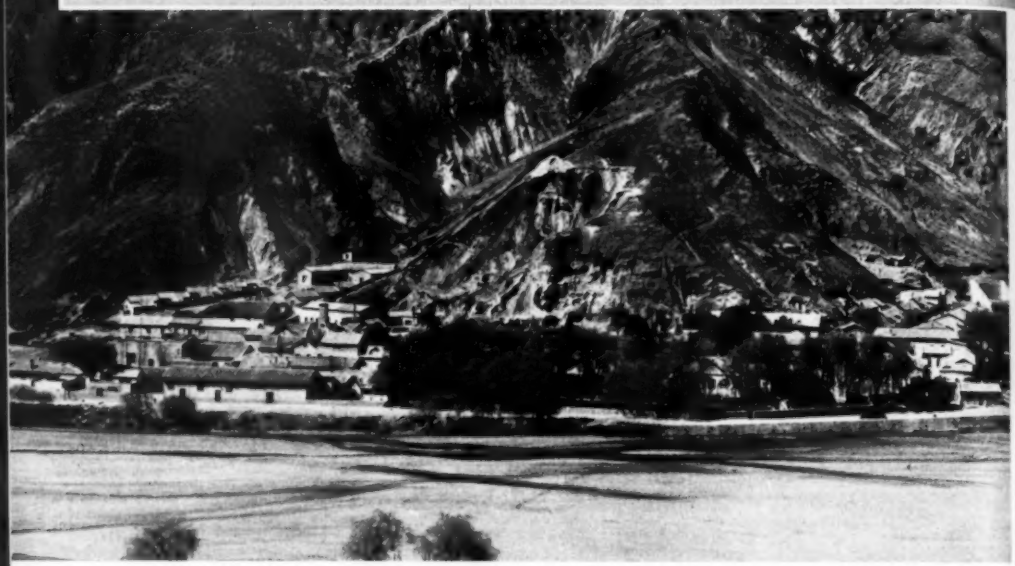
ONE-MAN RAFT

THIS ingenious life-raft is one of the newest devices designed to save pilots forced down at sea. Folded to the size of a duffel bag, *above*, the raft floats while the pilot twists a valve. This releases carbon dioxide from a pressure cylinder, *right above*, which inflates the raft in about five seconds. The pilot climbs in, *right*, and is ready to go, his oars fitted into holes which will prevent them from washing away. *Below*, the supplies that go into the raft kit.



CONTINENT OF TOMORROW

NO. 1: BOLIVIA



The tin roof of the world: a mountain of almost solid tin in Bolivia, land of uncounted treasure, waiting to be developed after the war ends. This is the Aramayo mine.

by Henry Albert Phillips

"LITTLE SIMON" kept a general store in a backward mountain community in Bolivia. The biggest thing that had come into his life was the mounting debt of the local land baron. The debt became so big finally that it scared Simon into a lawsuit. He won his case. But the court award was as bad as the debt. There wasn't any money; only land —a big hill.

"Little Simon" mounted his burro and went out looking for the worthless property that had cost him such a pile of precious provisions and goods. Just as he had feared, it turned out to be nothing more than a barren hill. He was so mad that he kicked the loose stones that covered it.

One of the stones glittered in the burning sun. He examined it and then gathered up

WHEN peace comes, aviation and the Pan American Highway will throw open the great treasure house of South America to gold and diamond and mineral seekers, to land hunters, to those who long for new frontiers and fresh opportunities. Perhaps YOUR fortune awaits you in this almost untouched continent. What is this fabulous territory like? How will you get there? What opportunities await you there? What will you find there? Mechanix Illustrated has commissioned Henry Albert Phillips, noted writer and South American explorer, to take you on a conducted tour, nation by nation, through South America, answering these questions for you. Here is the first of his series. Hop aboard for the Continent of Tomorrow!

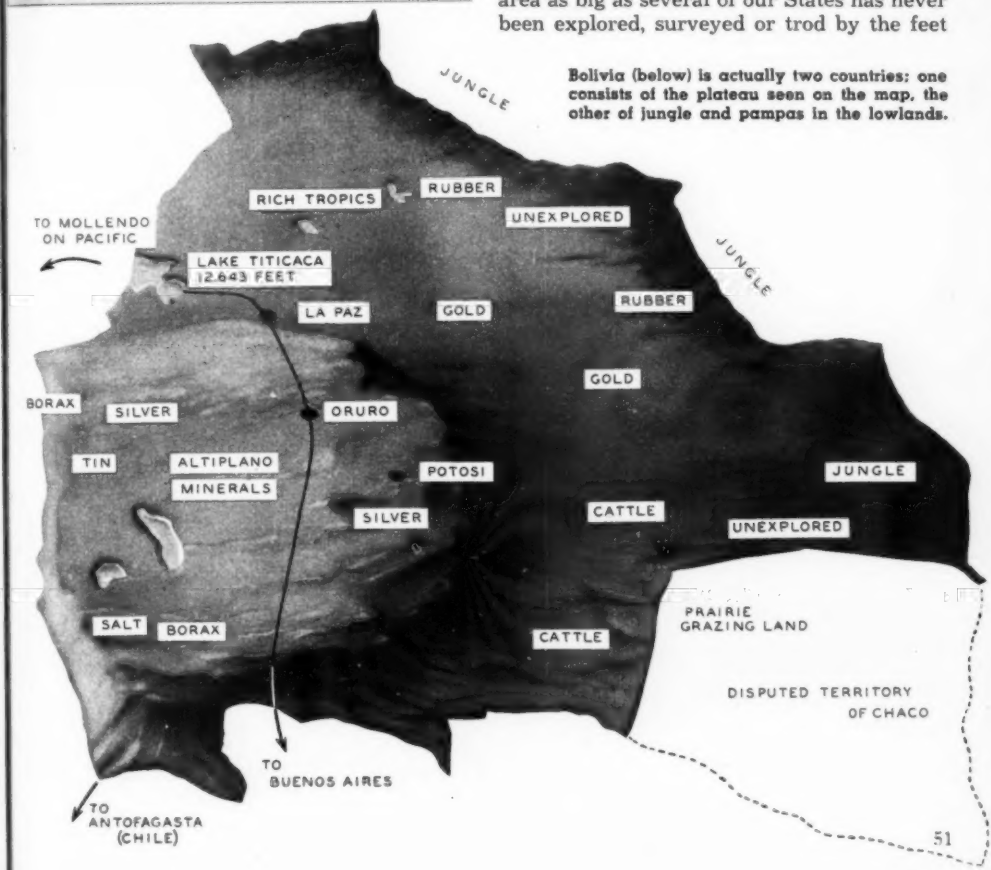
a little pile of them. They were all alike; heavily streaked with metal. He filled his saddle-bags with them and hurried back home, very much excited.

The government assayer in La Paz, the Capital, told him: "There's a lot of everything in these nuggets, my man. Silver, lead, zinc, quartz, tin. Mostly tin."

Today "Little Simon" is Simon I. Patino, the biggest man in Bolivia, the biggest tin magnate in the world and the richest man in South America.

The story of "Little Simon" sounds like a fable to us, but in Bolivia its truth is well known. Bonanzas like that are known to be lying hidden all over the vast mineral fields of the country. Finding them is just a matter of what Bolivians call "Patino Luck."

Bolivia is the least known country in the Western Hemisphere, despite the fact that it is larger than all the States of the Eastern Seaboard of the United States put together. The population is less than that of Chicago; seven persons to the square mile. A vast area as big as several of our States has never been explored, surveyed or trod by the feet



Bolivia (below) is actually two countries: one consists of the plateau seen on the map, the other of jungle and pampas in the lowlands.

A fortune awaits the man who introduces new farming methods into Bolivia. The primitive scene above shows a Bolivian farmer seeding his crop, using a wooden plow.

of white men. Finally, Bolivia is one of the richest countries on earth, in both natural resources and in pioneering potentialities.

Never, since the days when our own wide West was thrown open to pioneers has such a single strip of boundless and rich virgin territory beckoned restless, adventurous and fortune-seeking spirits.

Bolivia is an "interior" nation, thrust back several hundred miles from her one-time seacoast possessions by losing a war with Chile, to an obscure region overshadowed by the high Andes. There is no overland way of getting into Bolivia that does not scale the Andes Mountains!

Bolivia is also one of the strangest countries on the globe. Its 550,000 square miles are divided into two very unequal parts. It can be said that there are two Bolivias: Upper and Lower Bolivia. Except that both are part of a single Constitutional Republic (closely modeled after that of the United States) using Spanish as the official language, you might say that they have nothing in common.

Upper Bolivia occupies only about one-tenth of the Republic. It is about the size of Alabama, or Wisconsin. It is like an island in the clouds, ranging from two to three miles up in the sky; a cold, barren waste above the normal vegetation and timber lines; suffering from a chronic scarcity of fuel and food. Practically everything upon which civilized man subsists has to be imported; carried over the tops of Andean peaks via a three-day climb on a dinky one-horse, one-track, once-a-week railroad, or on the backs of Indians and burros. Bolivia has without doubt the worst transportation problem and accommodations of any country in the world. That has been one of the bottlenecks that have held back the development of Bolivia's rich resources to this very day, and will—until the war is over.

The bulk of the mineral treasures of Bolivia lie stored and waiting for the prospectors, miners and capital of Tomorrow, in Upper Bolivia. It is the Tin Roof of the World, where "Little Simon" Patino kicked up nuggets on his "worthless" hill. To the unseeing eye, it does appear worthless. Yet, nine-tenths of the population of Bolivia have climbed up and live on this Altiplano, or High Table, as they call it, drawn there from the earliest days by the human "treasure seeking complex."

Continued

Continent of Tomorrow No. 1: Bolivia

Crude device used to crush ore at the Chojlla tin and tungsten mine. New methods are badly needed.

The almost universal footwear of Bolivian Indians are these shoes made from sections of old auto tires.

But where do *you* come into the picture? How are you going to get down to South America, and then make your way into Bolivia? What about the food? Traveling facilities? Will the food and the altitude agree with you? How about the questions of language and currency?

The first of these problems to disappear after the war will be that of means of travel. Aviation will throw the country open after the war. The United States, on the day of victory, will undoubtedly have the largest merchant fleet in the world, and much of it, relieved of the strain of war, will flow into South American runs. And if you don't like traveling by boat, you can just fill up that new car of yours with high-octane gas and head south on the Pan American highway.

There's not one, but three gateways into Bolivia: one through Argentina, another via Chile. You'll probably take the shortest and most popular route, with an American liner dumping you off at Mollendo, Peru. After three days of steady climbing, you'll find yourself aboard an iron steamboat in the clouds. An all-night sail on Lake Titicaca, "the highest navigable body of water on the globe," and a half a day more by rail, brings you into the "highest Capital," La Paz, at an elevation of 12,000 feet.

If you're sound of wind and works, you'll soon get used to the elevation. Maybe you'll have an occasional touch of soroche, or mountain sickness, that'll put lead in your heels and ether in your head.

You won't find La Paz a hospitable city. Among its 250,000 inhabitants, there are few extra places at table, or beds for strangers.

Every container of water in Bolivia, under government orders, must contain live fish—to keep it clean.

The Sucre Palace Hotel is the only first-class hotel, if you're looking for sugar-coating and tinsel, at 600 bolivianos (Bolivian "dollars," currently 2 cents each) a day. But don't worry. There are a few second-class inns, like the Hotel d'Italia, at only 50 cents a day, U. S. A., and not so bad at that. The Indian barber just down the street will sell you a decent shave with a haircut for a nickel!

Sooner or later, you'll find that there are many things radically wrong in Bolivia's set-up. Maybe you're the fellow that can remedy some of them [*Continued on page* 149]

RETURN OF THE SPEARFISH

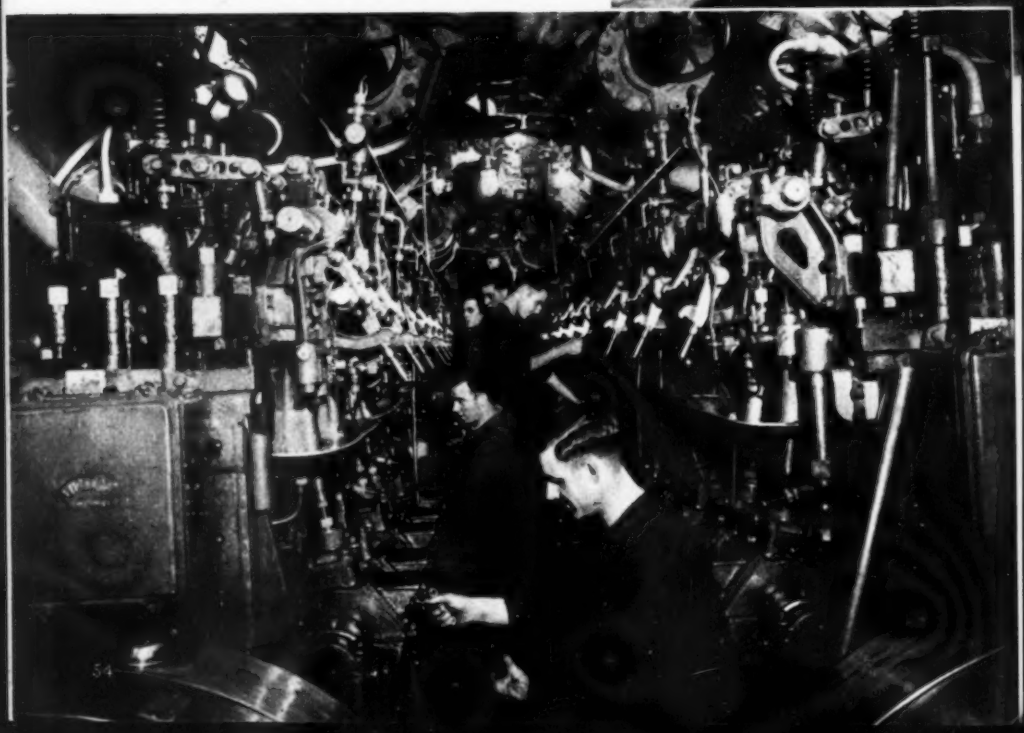
JUST after the outbreak of war, Lieutenant J. H. Eaden gave orders to cast off the Spearfish, and she slipped quietly away to patrol off the Norwegian coast. In a twenty-knot breeze under a lowering sky, she went steadily on her course. Altering helm to avoid being seen by a merchantman during the night, she dived before dawn to proceed beneath the surface for a couple of hours when, finding the seas empty, she came up to go ahead on her main engines.

By midday the wind and seas were increasing. There was no break in the heavy cloud. Once or twice during the day she changed course or dived to avoid being seen by merchant ships, and by midnight a northerly gale caused her to stagger and roll heavily.

Next morning the seas were running too high for her to proceed at periscope depth, for the waves washing over the periscope

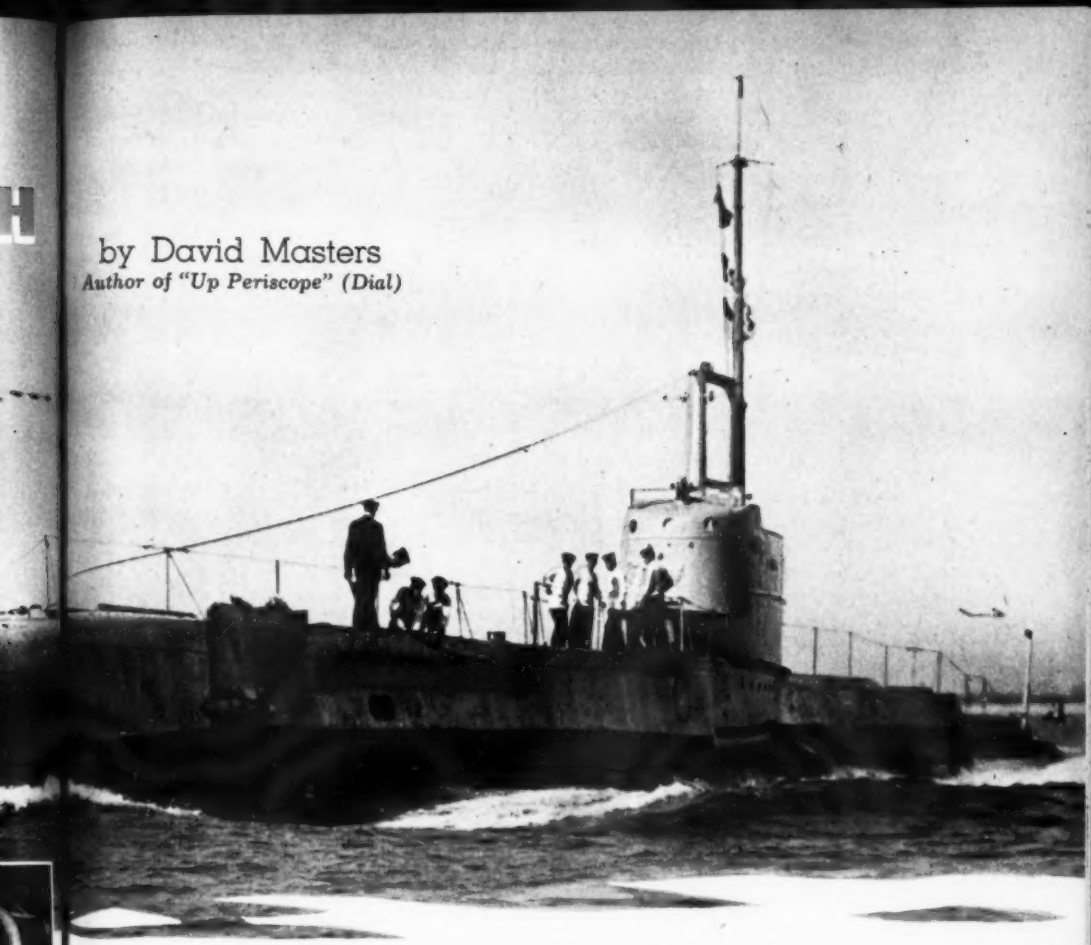
From Up Periscope published by Dial Press

At right, the valiant sub, Spearfish, after she torpedoed Nazi battleship, Admiral Scheer. Below, engineroom.



by David Masters

Author of "Up Periscope" (Dial)



made observation impossible, so she sailed on the surface, diving occasionally to dodge any merchantment she sighted.

By 1 o'clock in the early morning her lookout picked up the beam of a lighthouse on the Norwegian coast. Two hours later a big fishing fleet was sighted, so the Spearfish dived and rested a few hours on the bottom.

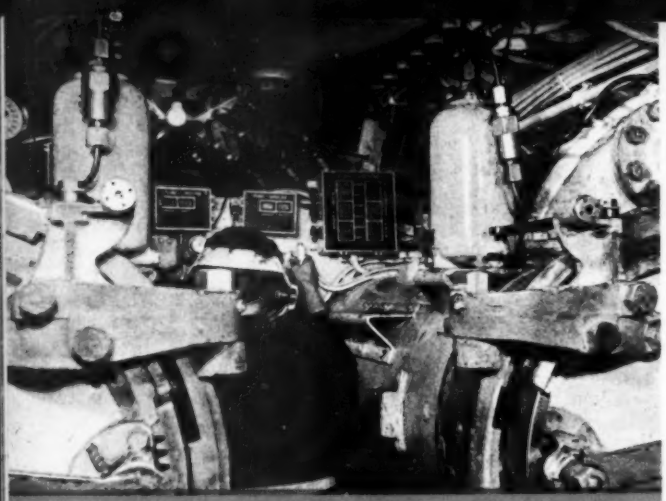
Just after 6 a. m. some of her pumps were started to enable her to go up to have a look round. Raising her periscope, her commander saw many trawlers flying the Danish flag with picturesque white hulls and red triangular sails. An artistic eye might have appreciated their pictorial quality, but the quiet eyes of Lieutenant Eaden appraised them from a submariner's point of view. The red sails were like danger signals, warning the Spearfish to avoid them—which was exactly what her commander did, for about 8 o'clock in the morning he took her to a lower level.

Ninety minutes later he went up to see what was going on. It was a bit of a shock when he barely missed bumping the keel of a trawler. "I nearly put my after periscope through the bottom," he said afterwards.

Lowering his periscope, he continued on his batteries for a couple of hours before taking her to the bottom where she settled down while her crew rested.

Darkness lay over the seas when the Spearfish surfaced. The crew got busy, fans were started to blow out the boat and change the atmosphere, the main engines were set to recharging the batteries, and the navigator manipulated the sextant to fix his position by the stars.

Early on Sunday morning, just before 4 o'clock, the recharging was completed. The crew had eaten their main meal of the day—or night—and the hatch closed as the Spearfish slid under the surface to a safe depth.



Above: One of the few released photos of the torpedo firing panel of a submarine, showing gunner's mate's cramped work quarters.

British subs have much more narrow quarters than American. Above, periscope station of the Spearfish.

Within half an hour the operator listening at the hydrophones heard a sound.

Sounds coming to the listening ears in a submarine call for instant investigation. They may mean danger, on the other hand they may indicate that a target is somewhere in the vicinity.

Then the keen ears of the listener detected a faint noise which told of a vessel moving ahead.

Other ears, enemy ears, were listening just as intently for the sounds made by the Spearfish and enemy hands were waiting to strike her a mortal blow. But the men in the submarine did not know. They could not see. They could only guess.

All doubts about the danger of those strange sounds were resolved in a big explosion which made the Spearfish vibrate like a tuning fork. At once her commander took her to the bottom and stopped all machinery.

The Spearfish was in a nasty position. She was caught in shallow water which made her very vulnerable, whereas a hundred fathoms would have given her a chance to go deep and steal quietly away. The best method of escaping the hunter was for the Spearfish to lie low and keep absolutely quiet in the hope that the enemy would grow tired and relinquish the chase.

From time to time those peculiar sounds came to the listeners in the submarine. Two hours passed, then Lieutenant Eaden made up his mind to go up to see if anything was in sight.

"Diving stations," he ordered, and instructed the engineer to pump out the main ballast tanks to take them to periscope depth.

Before the pumps had been working five minutes a heavy explosion shook the Spearfish. Instantly the commander ordered the pump and all other machinery to be stopped. Even the gyroscope of the gyro-compass upon which the submarine depended ceased to spin.

"See whether there is any damage and report to me," the captain ordered.

"The fuses of the steering motor are blown, sir," said the engineer. This, the only damage, was a simple matter to put right.

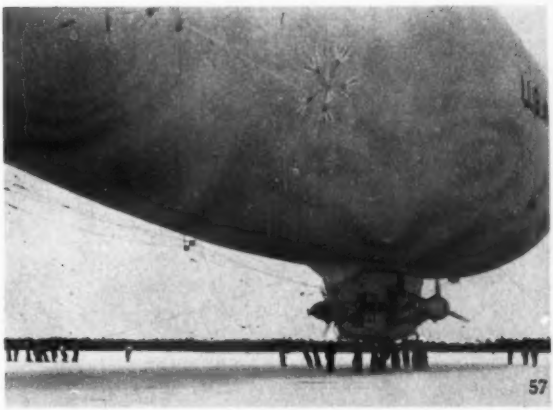
Ordering the crew to rest and keep quiet, Lieutenant Eaden waited to see what would happen. His hydrophones were sensitive enough to disclose that two vessels were hunting the Spearfish. There were other sounds which told of the hunters methodically sweeping for the submarine.

Just before 8 o'clock the hydrophones picked up the faint sound of a turbine.

Lieutenant Eaden thought things over. They were in grave danger. The enemy who had been hunting them for six hours was stubborn and [*Continued on page* 160]

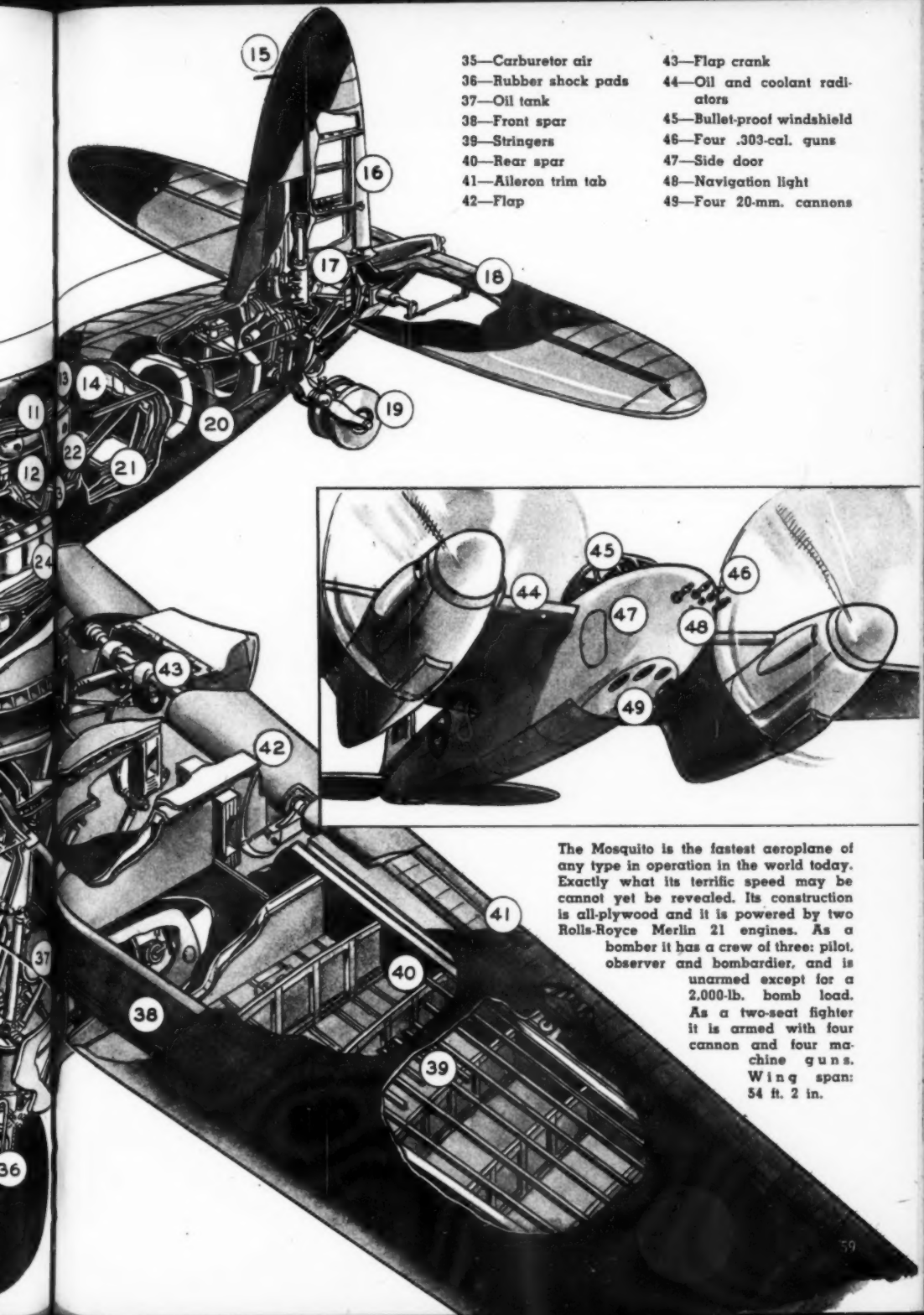
HAUL HER DOWN!

THE process of bringing a blimp in to a landing looks easy, as it's pictured here. She comes in low over the field, *above*, toward the waiting ground crew, watching the flag for wind direction. Forward lines are dropped and grabbed by ground men, *right*, who hold her steady while more lines are dropped. With a hearty, even pull all around she is hauled to the ground, *right below*, and sandbags are attached to hold her down. Weighted, her nose secured to a tractor-powered mooring mast, *below*, she is pulled into a hangar. But it's no cinch in a high wind.



THE MOSQUITO

1—Detachable wing tip
2—Landing light
3—Fuel tank 24 gal.
4—Fuel tank 32 gal.
5—Fuel tank 65 gal.
6—Fuel tank 79 gal.
7—Voltage regulator
8—Electric power unit
9—Collapsible boat
10—Fuel tanks 68 gal.
11—Compressed air
12—Bomb winch
13—Three-layer skin
14—Flare chute
15—Airspeed pitot tube
16—Rudder trim tab
17—Elevator balance
18—Elevator trim tab
19—Two-tread wheel
20—Spiral tail section resists twist
21—Camera mount
22—Rear camera
23—Rear door
24—Oxygen bottles
25-26—500-lb. bombs
27—Air duct
28—Fireman's ax
29—Heated window
30—Parachute stowage
31—Engine controls
32—Coolant header tank
33—Constant-speed prop
34—Rolls-Royce Merlin 21



35—Carburetor air
36—Rubber shock pads
37—Oil tank
38—Front spar
39—Stringers
40—Rear spar
41—Aileron trim tab
42—Flap
43—Flap crank
44—Oil and coolant radiators
45—Bullet-proof windshield
46—Four .303-cal. guns
47—Side door
48—Navigation light
49—Four 20-mm. cannons

The Mosquito is the fastest aeroplane of any type in operation in the world today. Exactly what its terrific speed may be cannot yet be revealed. Its construction is all-plywood and it is powered by two Rolls-Royce Merlin 21 engines. As a bomber it has a crew of three: pilot, observer and bombardier, and is unarmed except for a 2,000-lb. bomb load. As a two-seat fighter it is armed with four cannon and four machine guns. Wing span: 54 ft. 2 in.

HOTTER THAN HOT

by Darrell Huff and Lawrence Eldred

Dr. C. Guy Suits

The story of a clarinet player who found out what goes on inside a welding arc and produced temperatures hotter than the sun

FOR C. Guy Suits, science is a hot subject—literally. From the hot notes tootled on a collegiate clarinet at the University of Wisconsin to the hottest flames yet developed by man was only a couple of steps for Physicist Suits.

From the velocity of sound which measured the rhythms of sophomore dances to the velocity-of-sound method of measurement of high temperature welding arcs was for him the same natural progression as from toddling to walking.

And only a handful of years was needed for a little boy being introduced to science in his father's drugstore in Medford, Wis.,

to become assistant director of the General Electric Research Laboratory at Schnectady, N. Y.

Such is the saga of Scientist Suits.

And along the way are strewn many contributions to a better world in which we will live after the war is won.

His first major contribution was a method of electrical measurement of the moisture content of wood, enabling lumbermen and furniture makers to season wood to the prevailing average humidity in the geographical area in which the wood is to be used.

Then, as a by-product of his favorite sport, skiing, Suits invented an improved method for reinforcing the running edges of skis, and developed a theory of the mechanics of skiing.

A decade ago he gave theater managers and outdoor advertising men a boon when he developed a simple method of flashing lights without moving parts, using a simplified reactor-rectifier circuit.

But the most promising and important of all his works is Dr. Suits's research in electric welding arcs. He started on the premise that to use electric welding effectively, science must first understand what happens inside the hellishly hot little area of the welding arc itself. Suits concluded industrialists must know which temperatures are best suited for which materials, and how to measure accurately those temperatures.

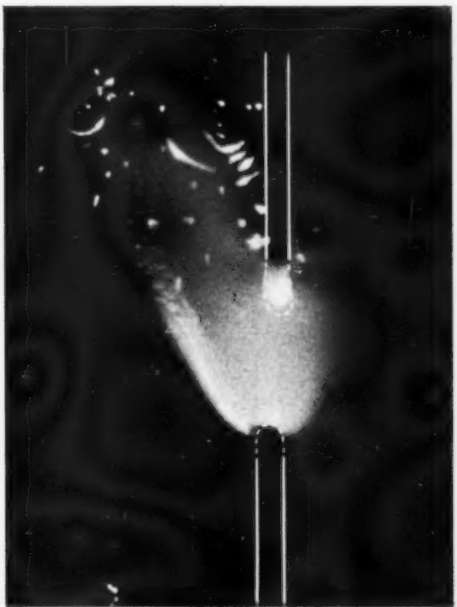
Between the premise and the result were long years of painstaking study coupled with giant leaps of genius and intuition. For young Suits there were years of patient exploring in dark new worlds, coupled with sudden, sure flights over unknown jungles lit by the bright searchlight of certain knowledge.

And the results show up in America's achievement of amazing record-breaking war production by welding. Warships, warplanes, wartanks are rolling off American production lines faster, better, and cheaper than anywhere else in the world.

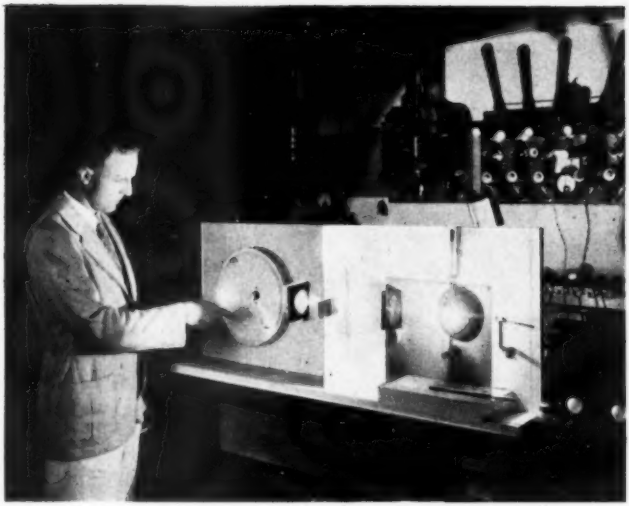
Laborious riveting is rapidly giving way to fast streamlined welding with an importance so great in the ultimate Allied victory that Dr. Suits in truth has become another American "soldier of science"—who fights behind the men behind the guns.

When, on March 12, 1905, a son was born to Chauncey G. and Otillia M. Suits in the City of Oshkosh, Wis., and later was christ-

Ultra high-speed motion pictures enabled Dr. Suits to discover what happens in a welding arc. This is a picture of atomic-hydrogen arc. Note molten pool at bottom.



An arc in a nitrogen atmosphere, using tungsten electrodes. It shows graphically how particles of the tungsten fuse wire fly out in the arc by electronics.



Dr. Suits sends sound waves through a welding arc, makes photographs of the sound waves and from the photos calculates the heat of flames.

ened Chauncey Guy Suits, there was little indication that before he was 30 he would be called "foremost young electrical engineer of the generation."

When the Suits family moved to Medford and the father set up his own drugstore there, little Guy quickly decided he was going to be a scientist some day. Until he was graduated from Medford High School he was a soda jerker for his father. He also learned to play the clarinet.

At the University of Wisconsin Guy gave clarinet lessons—to as many as thirty-five students a week. He played clarinet and was an announcer over the university's radio station, WHA. He played hot clarinet licks for student dances.

Almost incidentally he was a scientific student who had garnered membership in four honor societies—Phi Beta Kappa, Sigma Xi, Phi Sigma Phi, and Phi Mu Alpha—by the time he was graduated with a bachelor of arts degree in 1926. He had majored in physics and mathematics.

Suits received his master of arts degree in 1927 while working as a physics consultant in the United States Forest Products Laboratory at Madison and as a student instructor in the physics department of the university.

The rising young scientist was already recognized as so worthy that he received Wisconsin's first exchange fellowship at a Swiss university.

He went to the Technische Hochschule at Zurich, considered at the time the best technical school on the continent. He received the degree of doctor of natural science there in 1929.

It was while he was at Zurich that he took up skiing, a sport hobby which has stayed with him ever since. Even in skiing, though, his scientific mind was at work. He calculated some of the mechanics of skiing, then combined with his theorizing the practical work of inventing a new method for strengthening the running edges of skis for improved wear and sport.

His academic specialization at Zurich was the experimental and theoretical study of the application of vacuum tubes to thermionic volt meter circuits. For his studies in this polysyllabic mouthful the university bought samples of every kind of vacuum tube manufactured.

In 1930 Suits joined the staff of the Research Laboratory at General Electric. Ten years later—at the age of 35—he became assistant to the director of the laboratory.

In 1937 he had received the Eta Kappa Nu (honorary electrical engineering fraternity) award for his work with arcs and gases—work which developed into a subject for physics textbooks called Suits' Law of Similitudes.

According to this law an arc in one gas can be made similar to an arc in any other gas by manipulation of the pressure of the gas. In demonstrating his theory six years ago before members of the American Institute of Electrical Engineers, Suits set up an electric welding torch behind a frosted glass screen. In an atmosphere of hydrogen he passed a brilliant arc between the electrodes of the torch, and showed it magnified and projected in color on the screen.

The arc in hydrogen showed broad and vivid and about two inches wide. Suits then produced an arc in an atmosphere of nitrogen, stepped up the pressure to 1,200 pounds per square inch, and the arc brightened until it was similar to, even indistinguishable from, the arc produced in hydrogen. By classifying these arcs, Suits can predict the shape and behavior of an arc [*Continued on page* 158]

THE CHINESE SOLDIER

by Major Malcolm Wheeler-Nicholson

THE Chinese soldier—ten million of him—is the great reserve of United Nations fighting strength in the Orient, the ace-in-the-hole that may finally bring the Nipponese war lords crashing to their fall.

What manner of man is this Chinese soldier, and what makes him tick?

My first view of the raw material that goes to make the Chinese soldier was in the last war, when we took aboard at Tsing Tao several thousand Chinese coolies organized into labor battalions for service on the Western Front. They were Shantung men, huge six-footers, deep chested, powerfully muscled and moving with slow certitude that gave an impression of great power. They were organized into companies and battalions and in everything but weapons looked like first class fighting men. There was a British officer aboard the ship, who had served with the Weihaiwei regiment.

"They make excellent soldiers, none better," he said. "When they first join up, the blighters have a fixed idea that the higher they set the sights the harder the gun will shoot. But once they get the idea and have something to fight for, there are no better soldiers in the world."

The Chinese soldier had little to fight for at that time. But these same coolies on the Western Front in the last war showed traces of the one quality that will eventually prove them the undoing of Japan. The occasion was the bombing of the Chinese labor battalions camp behind the lines by some German planes. Fifteen or twenty Chinese were killed and wounded. The survivors gravely surveyed the wreckage and then raised their heads to stare at the barbwire that enclosed a German prisoner-of-war camp near by. Between the two camps was an ammunition dump. The next morning the coolies, marching to work, halted opposite the ammunition dump. Without a word they broke ranks, each coolie helping himself to several hand grenades, and re-formed quietly to continue their march. Arriving opposite the German prison camp, again they broke ranks, but in quiet and orderly fashion, without a word

The mark and pride of the Chinese soldier is the historic crooked sabre of China. This queer blade is still carried by every Chinese infantryman who can obtain one of them.

being said. Each coolie then proceeded methodically and calmly to remove the pins and to heave his store of grenades into the crowded prison pens.

American and British officers, brought to the scene by the sound of the explosions, were helpless. Before armed aid could arrive to prevent them, the Chinese exhausted their store of grenades, practically blotting out the prisoner-of-war camp. Then they fell into orderly ranks once more and resumed their march to the scene of the day's work.

Again, in the last war, Chinese troops from Canton were serving with our Allied Forces in Siberia. They were excellent troops, quiet, orderly, well behaved on the march and in camp. But the arrogant Japs couldn't let them alone. A self-important and cocky little Japanese colonel, backed by his regiment, seized a dozen native ponies from the picket line of a lone Chinese company engaged in guard duty on the railway line near Spasskoi. The Chinese soldiers looked on impassively. The Jap colonel and his regiment resumed their march to go into camp some two miles farther on. That night the members of the Chinese company slipped out of camp, marched to a commanding position on the flank of the Japanese regiment's camp, set up their machine guns and phlegmatically wiped out several hundred Japanese soldiers. This done, the Chinese picked up their empty cartridge cases, retraced their steps in the darkness and quietly went back to camp. To save face, the midnight slaughter was reported by the Japanese as an attack from Communist guerrilla forces in overwhelming numbers. Thereafter, however, the Japanese were notably less arrogant when in contact with Chinese military forces in Siberia.

It is the Chinese soldier's implacable sense of retributive justice that will eventually prove the undoing of the Japanese in Asia. So far the Chinese soldier, like the Russian, has been forced to trade space for time. But in the organized millions of the Chinese soldier, and the in-

Continued

The Chinese Soldier

exhaustible reserves of manpower behind him, there is doom for the Jap.

The fighting ability of the Chinese soldier should have caused no surprise to the world had it remembered the adage that warns of "the wrath of the patient man."

For the Chinese soldier is individually and collectively a vast tower of patience, the product of countless generations of patient farmers, who have tilled the soil, fought flood, drought and famine and survived to carry on. The Chinese soldier is at heart a peasant farmer, who only wants to be let alone, to live in peace to cultivate his few acres of soil and to do honor to his ancestors. The restless Japanese gadfly insisted upon attacking this Chinese elephant. So much the worse for the gadfly. It has roused against itself the implacable anger of the Chinese elephant, an anger that nothing but the complete destruction of the Japanese gadfly will satisfy.

The Chinese fighting man wants nothing more than to get the job done and get back to his few acres. Hundreds of thousands of him have been fighting for nearly ten years, longer than any of the soldiers of the United Nations. He has fought sometimes only with a broad bladed sword, often with only one rifle to be shared with two or three men, latterly with more Chinese-made rifles and a few machine guns, trench mortars and a few, pitifully few, field guns along with an increase in American airplanes. On good days he lived on a handful of rice. On bad days, he tucked in his belt and grinned. Single regiments of him under such conditions have held lines that should have been held by a division. When forced to fall back, he has trudged to the rear, [*Continued on page* 152]

A Chinese general, unidentified in captions passed by the censors, is seen directing troops in field.

An officer of the Chinese 29th Army. Note the unusual westernized expression, typical of new troops.

The Chinese foot soldier. There are 10,000,000 of him, and he has been fighting Japs for ten years!

DECEIVE YOUR SENSES

by Roy Lester

SEEING isn't always believing. Nor is smelling, feeling, hearing or tasting. Your senses, as a matter of fact, are pretty gullible. They go, hook, line and sinker, for any number of tricks. On these pages are a few simple methods by which you may prove to your own satisfaction that your senses are far from infallible.

They're easy to try, and the results are guaranteed to surprise you.

Touch the base of your tongue with a stick. You get a sour taste. Stimulating your sour taste buds does it.

Now touch your tongue tip lightly. You will get a sweet taste. Your sweet taste buds are found here.

Put a candle in front of mirror. Put a pane of glass in front of candle. You will see many rows of candles.

If you will blindfold your eyes and plug one ear, you can't locate a clock from its ticking in the room.

With eyes and nose closed, you will find it impossible to distinguish the taste of a potato from an apple.

Place a zinc spoon on top and a silver spoon on bottom of tongue. You get a bitter, vitriolic taste.

Close your eyes and touch a football with your two index fingers crossed. You'll feel TWO footballs.

Put one hand in cold, the other in warm water; then both in lukewarm. Note the twisted heat sensations.

Two points placed on your back simultaneously feel like one point only is touching. See next photo.

But when two points are placed simultaneously on your hand, you will be able to feel both distinctly.

ENGINEERS FROM THE CLOUDS

Tractors and bulldozers now have wings. Above: a sample of the many types of heavy construction machinery, streamlined, now flown into the hottest action by the U. S. Army Airborne Engineers.

by Bernard Wolfe

ALL day long, and far into the night, our Flying Forts and medium bombers, behind a thick screen of fighters, pounded hell out of that Sicilian airfield. Wave after wave of blockbusters and incendiary bombs hurtled down on the doomed clearing until it was a crackling inferno of flame and smoke. Every plane caught on the ground was blown to smithereens. Buildings and gun emplacements crumbled to smoldering ruins.

Meanwhile, from 5-inchers and 6-inchers on our battleships standing offshore, withering salvos arched into the surrounding hills to hammer the enemy's big guns and pillboxes, guided unerringly to their targets by reports from aerial observers. Big-caliber howitzers, entrenched far over the hills southward, lobbed countless rounds of high-explosive shells down upon the enemy strongholds ringing the field. Long before daybreak the area for miles around was softened up enough to risk sending assault troops in.

When the air base was a bomb-pocked wasteland strewn with wreckage and mangled bodies, the paratroop transports loomed up from the south, right on schedule. Hundreds of soldiers, armed to the teeth, plummeted to earth and commandeered the field with few casualties. Straggling remnants of the pulverized Italian and German forces retreated to the wooded foothills, where they were held off by blasting Tommy guns and brand new M3 submachine guns.

Then when the first feeble shafts of sunlight were beginning to filter through the Mediterranean mists, another Army cargo plane winged its way in over the field. In its wake came another lumbering giant, then another, then a fourth. All told a dozen or more planes came over, most of them towing huge gliders.

The pilot of the first C-47, assigned to this ticklish mission by the Troop Carrier Command, could barely make out the flaming hangars and other wrecked installations that marked his objective. Clouds of smoke billowing hundreds of feet into the air made it hard for him to see. Straining his eyes, he scanned the entire length and breadth of the

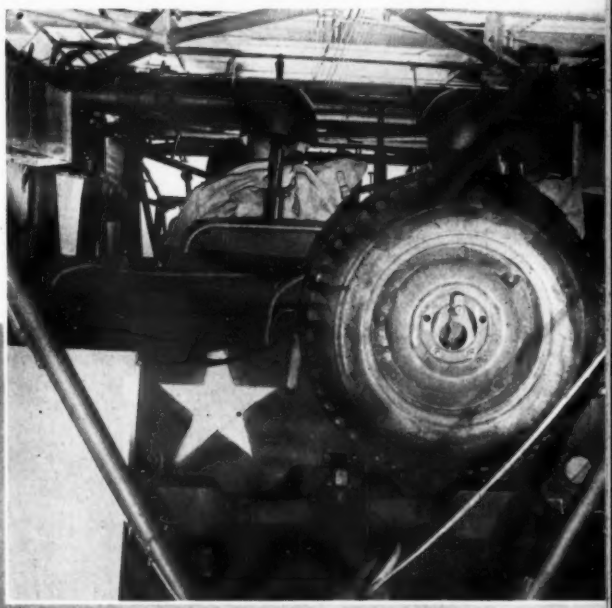
ruins, painfully tracing the littered path of each runway.

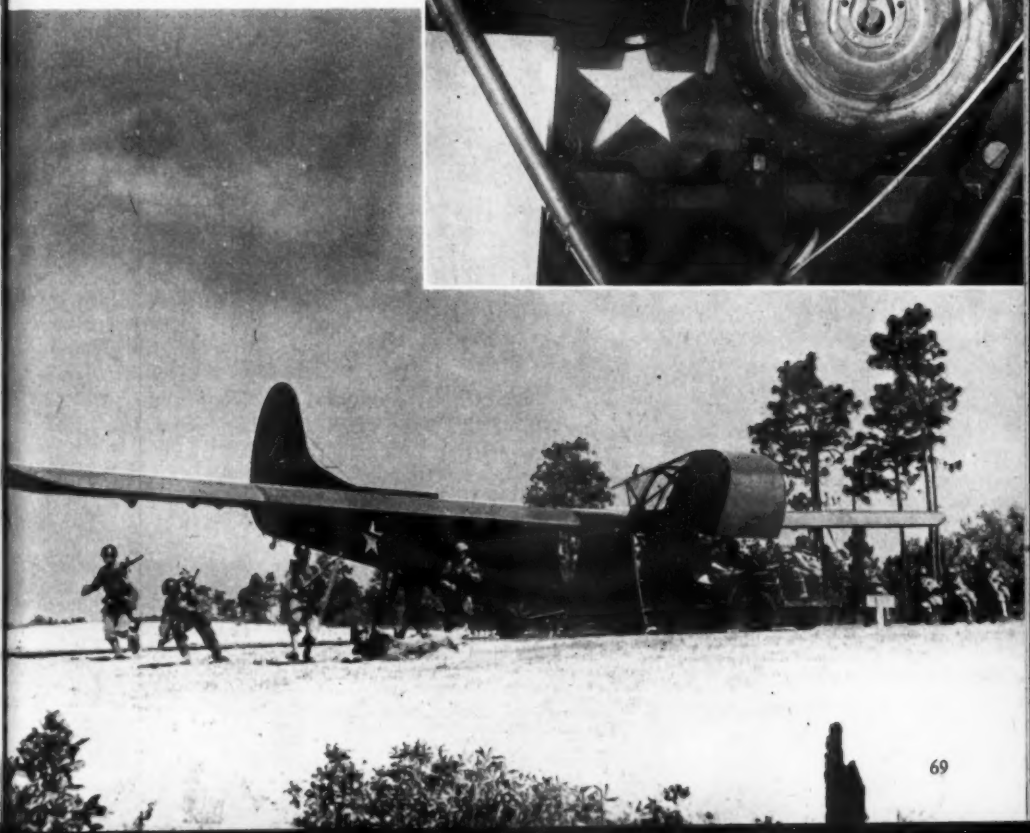
The bombers preceding him on this assignment had done their job well. The field was cluttered with the debris of planes and machine shops blown skyhigh; the landing strips were, for the most part, stretches of gaping craters. But one runway had been left almost intact. The transport pilot, taking a deep breath, murmured a silent prayer of thanks for Norden bombsights and steel-nerved bombardiers with split-second reactions. That clean, shining strip of concrete with hardly a dent to mar its surface was like news from home to him.

"Hold tight, you guys," he called out to his passengers. "Guess I'll try to go in now. May be a little bumpy, but there's just about enough smooth surface left on one runway—I hope."

Nobody seemed to notice his last words. There was a businesslike flurry of activity in the plane as the men gave themselves a last-minute once-over. Privates hitched their Garands over their shoulders. Those with corporal's stripes grasped Thompson submachine guns, and the two lieutenants aboard took up their carbines. The sergeants in the outfit slung '03 rifles into position and patted trouser pockets to make sure that their M9 antitank grenades were handy.

Technically speaking, these quiet, alert men were not fighters. As part of a company of Airborne Aviation Engineers, their job was to rush into captured airfields behind paratroops and infantry shock troops and restore



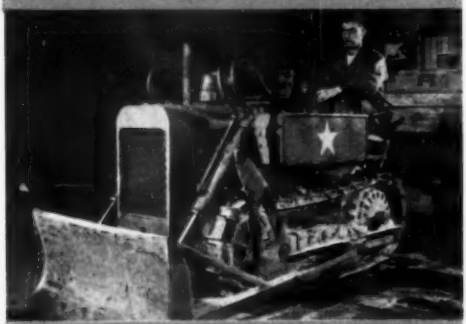


A jeep roars out of a glider's nose the moment the glider hits the ground. In the photo at right the jeep is shown in its riding position for air trips, soldiers ready at the wheel to drive off at the moment of landing.

Flying air compressor.

Airborne dirt scraper.

Tractor for the clouds.



Above: Sky bulldozer.
Below: Dirt loader.

them to use. Months before, General "Hap" Arnold, chief of the Army Air Forces, had defined their task neatly when he explained that air power is a "three-legged stool," the first leg being pilots, the second planes, and the third bases. They were to supply a sturdy third leg for the stool, as close to enemy lines as possible and sometimes even behind them.

But for a bunch of grease-monkeys and tractor jockeys they packed a murderous amount of fire-power, and they knew how to use it. Operating as they did under the shifting conditions of the front, they never knew when they might have to scurry from their earth-moving machines and begin taking pot-shots at dive-bombing Stukas or snipers in ambush. It was best to be prepared. The men fingered their shirt pockets for the reassuring feel of morphine syringes and packets of sulfa drugs. They stood quietly, grouped around the jeep which was strapped down tightly in the center of the plane.

Few of these stony-faced engineers could have named their whereabouts just then. Maybe below them was the Ponte Olivo field inland from Gela; maybe this time it was a base near Agrigento, Sciacca, Castelvetrano or some other unpronounceable town through which American ground forces were pushing. For over a week now, ever since they had been roused from their Tunisian bivouac to be packed unceremoniously aboard their C-47's and gliders, the men of this company had been on the move. They had put seven airports back into commission in as many days, rebuilding one and then shoving off before they could even take a look around and get their bearings.

By now one place [*Continued on page* 156]

An assortment of streamlined, junior-sized but capable earth-moving machines transported by air.

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SLEIGHT-OF-HOUSE

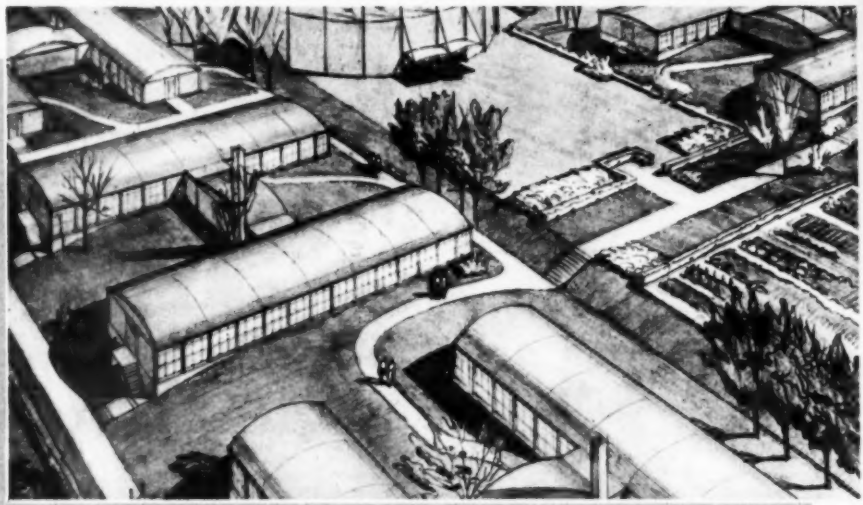
A demonstration Ratio unit, showing movable facade panels being placed in position. Fixed columns support roof, hold exterior walls.

Door-panel is easily fitted into wall.

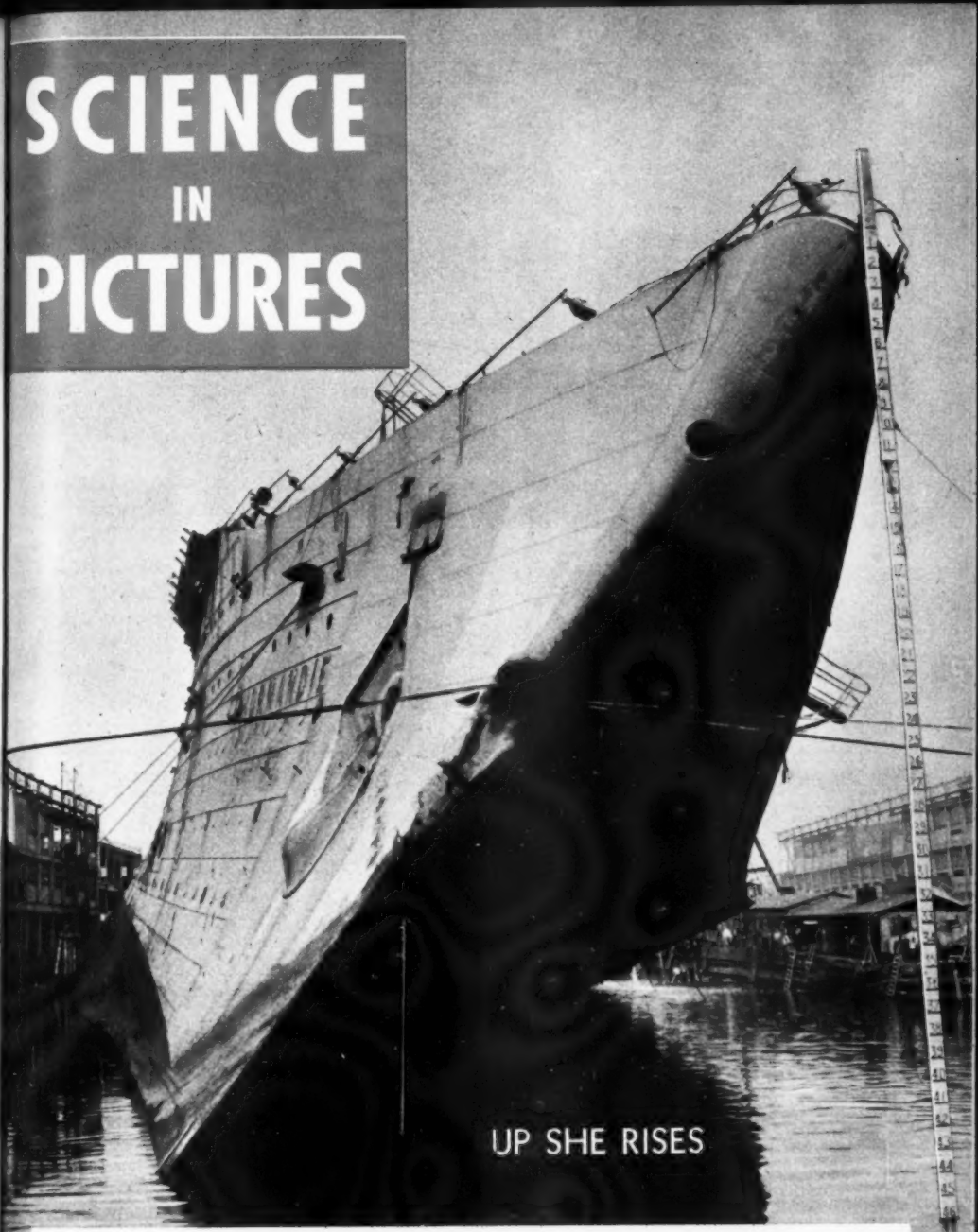
RATIO STRUCTURE is the name given to this new type of flexible housing, recently accepted by the Government for wartime use. With interchangeable parts and non-weight-carrying walls, a Ratio structure can be converted from dwelling to hospital, school or warplant, or whatever else may be needed.

Ceiling sections, above, are held in place by cleats, may be of any suitable insulated, light material.

Design for a Ratio development, below. Dormitories now, these could easily be joined into a single unit.



SCIENCE IN PICTURES



UP SHE RISES

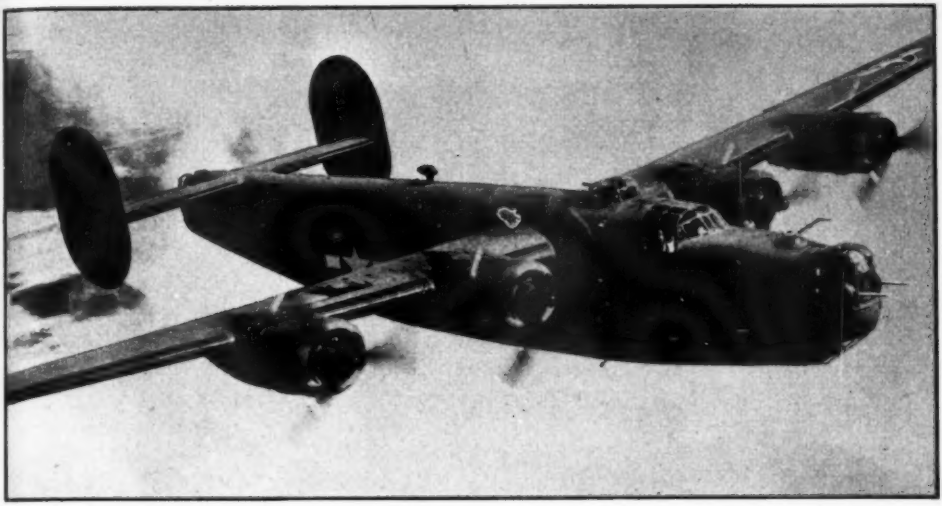
EIGHTEEN months ago U. S. Navy divers began ripping out the insides of the capsized giant U. S. S. Lafayette, better known as the onetime French Line blue-ribbon Normandie, wrecked by a disastrous fire. Working by feel in the muddy waters of the Hudson River, they built twenty-one concrete compartments inside the hull of the 53,000-ton ship; installed pumps to empty her. Last July, as this biggest single marine salvage job in history came to an end, up she rose.

A Jeep Can Do Anything

EVERYBODY knows that the U. S. Army's famous little miracle-buggy, the Jeep, is tough, versatile and accomplished. Some soldiers even say that Jeeps will report automatically, engines warmed up, when their drivers whistle for them. But not until recently have Jeeps taken to railroad work. Pictured *above* is one of them, in Australia, busily hauling cars in a switchyard; it's a standard model, except for the steel wheels.

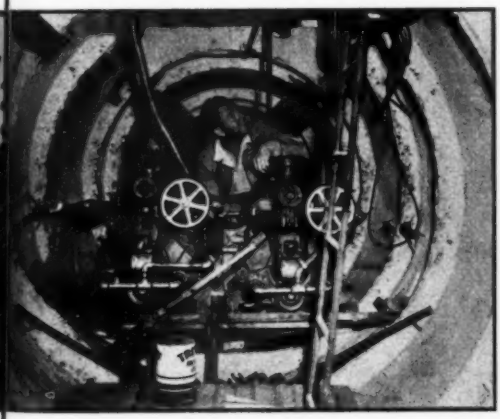
100% Less Gasoline

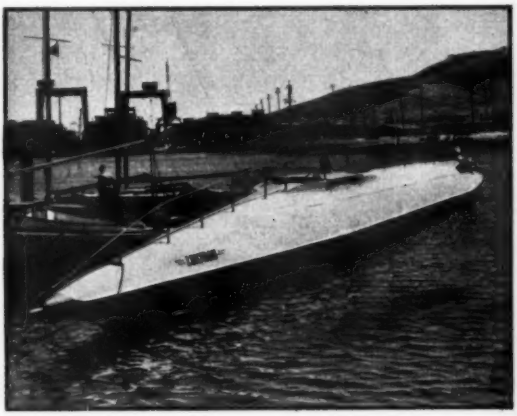
ALL the pleasure-driving he wants on no gas at all is the happy privilege of Mr. C. C. Mershon, of Philadelphia, shown *above* with his ration-proof car. An inventor and manufacturer of grates, Mr. Mershon foiled the gasoline shortage by getting himself a 1922 Stanley Steamer chassis, putting an old Buick body on it, and completely overhauling its coal-burning power plant. And now he drives to the race-track as often as he likes, makes the 75-mile run to Atlantic City almost every week end.



Punch In The Nose

ABOVE is the first flight picture of a B-24 Liberator bomber equipped with its newest item of armament—an electric gun turret in the nose. Carrying two synchronized .50-caliber machine guns, the added turret brings the Liberator's arsenal to a total of 13 guns. Enemy fighters accustomed to trying to point their attacks at the Liberator's heretofore comparatively vulnerable nose will now alter their tactics—or else.





Concrete Supership

DESIGNED by Hal B. Hayes of Richmond, Calif., to travel half-submerged, the Lektron, shown *above*, is the first experimental model of what is said to be a revolutionary type of shipping. Built of reinforced concrete in the shape of a torpedo, a big ship of the Lektron type, says Mr. Hayes, could cross the world's oceans at a speed as high as 75 knots carrying either cargo or passengers, and would present a minimum target to lurking submarines. Trials of the recently launched Lektron are being covered for readers of MECHANIX ILLUSTRATED by Captain Charles Borden, on special assignment.

Tough Truck

SHOWN *above* is the U. S. Army's newest Cargo and Troop Carrier truck, a six-wheel-drive juggernaut that can climb a 62 per cent grade, plow through sand, brush, or water three feet deep making its own road as it goes. Capable of carrying 16 fully equipped soldiers, the new truck has passed intensive tests to show it can also operate in temperatures of 140 degrees or 60 below zero, is now going into quantity production.

Iceless Prop

ICE that forms on the whirling propeller blades of planes flying high and fast through cold but humid air is a fliers' problem fully as serious as wing ice, and much more difficult to do anything about. At *right* is pictured a device recently developed to defeat it by Dr. Louis Marick of the United States Rubber Company: a strip of rubber along the edge of the prop blade chemically treated so that it can act as a conductor of electricity. Current passing through the rubber heats it to keep ice from forming, no matter at what height or speed the blades are whirring.

"Secret Weapon" At Work

RELEASED through a neutral source, the picture at *left* shows the new "secret weapon" supposedly being used by the Nazis in air defense: fog-throwing rockets. Multi-gun batteries are said to be able to throw smoke, fire and explosive shells all at once. But it all doesn't seem to be doing the Nazis much good.

Jeep In The Water

BESIDES doing railroad work (see page 74), Jeeps now go swimming, too. The one shown *above* being tested at the Willys-Overland proving grounds has been waterproofed, fitted with a periscope exhaust, and is pulling a newly designed amphibious trailer which can carry a quarter-ton load on land or water, take as much rough treatment as the Jeep itself.

Glass vs. Bullets

TO LINE leakproof gas tanks for combat aircraft, plane builders are turning from steel to woven glass. At *left* Harry Woodhead, chief of Consolidated-Vultee, shows the difference in bullethole-sealing properties of steel, resting on the ledge, and the new material, in his hand. Note much smaller holes left by bullets in glass sheet, indicating superior sealing quality.

Desert Scout

DETAILS have just been released of the British Morris Mark I light reconnaissance car, *right,* which was a minor star in the great campaign against Rommel (remember him?) in North Africa. Lightly armed with a Bren gun and a small antitank gun, the Morris Mark I has a welded armor-plate body, a 4-cylinder engine developing about 70 brake horsepower, rear wheel drive, can travel in almost any terrain, turn its 13-foot length on a sixpence.

Higher And Higher

THE turbo-superchargers that enable our war planes to reach altitudes of 40,000 feet or more are improving almost as rapidly as the planes themselves. At *left* a workman adjusts a two-speed, two-stage supercharger of the type used with the new Rolls-Royce engines being built by the Packard Motor Car Company for the North American P-51 Mustang fighter. A supercharger like this, it is said, compresses air at high levels to six times the surrounding atmospheric pressure, makes it possible for planes to fly two miles higher than they could before.

Aluminum Attraction

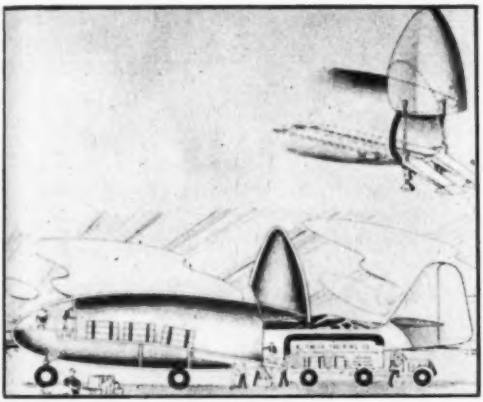
THE well-filled sweater shown in the picture at *right*, designed for use with evening dress, is made of a new material—aluminum yarn, colored to resemble gold. Production of this yarn is limited to the small amount necessary for experimental purposes, is expected to remain so until after the war, when it will become available for general civilian use. And if it can make every girl look like this one, we're certainly in favor of it. Her name is Lorna Deane.

It Can Happen Here

IN OIL-POOR Germany the synthesizing of gasoline from coal to feed the Nazi war machine has for years been a major industry. At *left* Secretary of the Interior Harold L. Ickes demonstrates the result of a successful American experiment with the same idea. After showing Representative Jennings Randolph and Senators Chan Gurney and Abe Murdock how it works in a model motor, Mr. Ickes endorsed a Congressional proposal to build pilot plants for performing the synthesis on a larger scale.

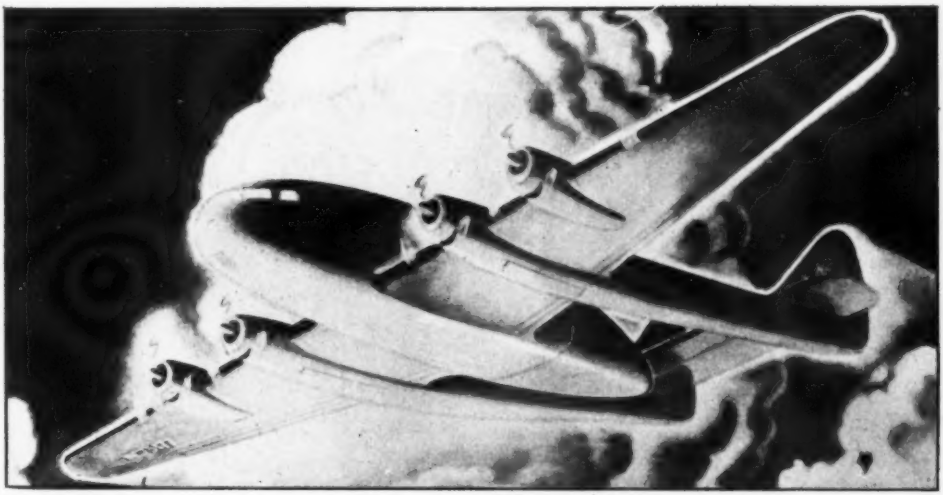
Amazing Amplidyne

THE short circuit, regarded by armchair electricians as efficiency's No. 1 enemy, is the essential characteristic of a unique new control device called the amplidyne. Developed by Dr. E. F. W. Alexanderson of General Electric, shown at *right*, the amplidyne is what enables a turret-gunner in a bomber to swing his heavy turret in any direction he likes against a 400-mile-an-hour air stream as easily as he would aim a rifle on the ground. Other amplidynes reduce complicated and huge jobs like running a steam shovel or handling ingots in a steel mill to simple and instant finger-tip control.



"A World You Never Knew"

AT *LEFT* and *below* are shown drawings of a new type of airplane, intended to work as an aerial freighter after the war, designed by Willem D. van Zelm of Glenn L. Martin's Engineering Department. Not merely an adaptation to cargo-carrying use of a present-day plane design, this one is to be specifically built for hauling freight. Plans for two models have been patented; both are low-wing monoplanes. The two-engined model would weigh 30 tons; the four-engined one, shown at *left* being loaded and *below* in flight, would weigh 43 tons, be able to carry 13½ tons of cargo.



High Jump

THE highest parachute jump ever made in America was recently completed by Lieutenant-Colonel W. R. Lovelace, *left,* of the Army Medical Corps, to test emergency oxygen equipment proposed for use by fliers who might have to bail out at great heights. Dr. Lovelace, formerly a fellow in surgery at the Mayo Clinic, where he specialized in research of the effects of oxygen on the human body; and now Acting Chief of the Army Air Forces' Aero Medical Laboratories at Wright Field, made his record-breaking leap from a Flying Fortress at a height of 40,200 feet. It was not a delayed-opening jump. Said Dr. Lovelace after landing safely at the end of his 24-minute downward trip: "I found out exactly what I wanted."

Bypass Pipe

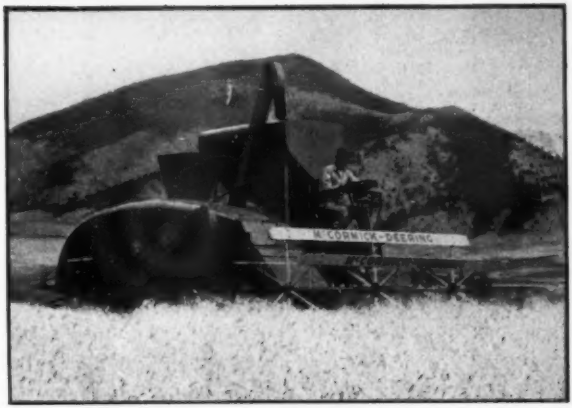
THE same sort of bypass tube used on steam locomotives has been adapted to the smoker's use by John B. Swan, of Gladstone, Michigan, shown at *right* with his recently patented bypass pipe. A veteran railway engineer, Mr. Swan claims the extra circuit insures clear smoking, helps to overcome the effects of clogging. The unique pipe is not Mr. Swan's first invention; a track-sander he devised is widely used by railroads.

Wrong-Way Well

THE well-drillers pictured working at *left* are going down after water, but not for the usual reason. In many parts of Florida wells are driven to underground rivers, sometimes as deep as 1,200 feet below the surface, not for the purpose of bringing water up, but to act as channels for it to go down. Known as drainage wells, these outlets for excess surface water serve to keep water levels regulated where usual methods of drainage are not sufficient; some of them are even used for carrying away garbage. This well struck gold ore on its way down, brought up three ounces.

Power Combine

A BRAND new development in farm machinery is the self-propelled combine, pictured at *right* working in a wheat field in Montana. By eliminating the need for a tractor, designers of the integral-motor combine have been able to place the cutting mechanism and grain platform in front of the operator's position, make the machine adaptable to all crop conditions. This model cuts a 12-foot swath, expected to be useful chiefly on large farms.

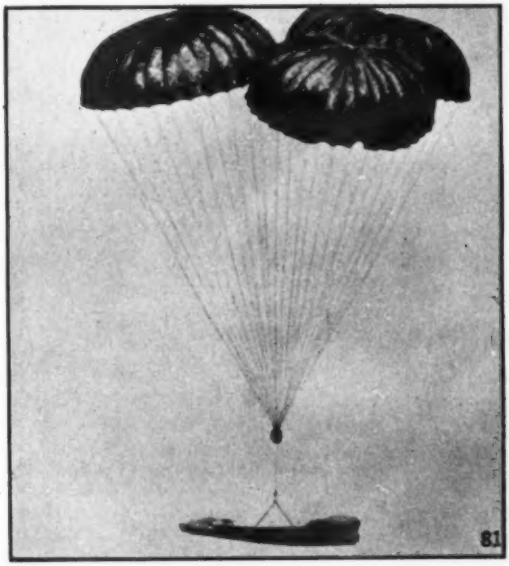


Bombs That Stick

AN EFFECTIVE British weapon newly removed from the secret list is the sticky bomb, shown at *left*. The body of the bomb consists of a glass flask to hold the explosive; this flask is covered with a woolen jacket, which in turn is treated with adhesive. Result: when one of these is tossed at an enemy tank it sticks in place until its charge goes off. The picture shows how protective casings are put on the bombs, to keep their adhesive from drying out.

Lifeboat Parachute

MEN adrift at sea near the British Isles can now look toward a new form of help—the airborne lifeboat. Developed by the RAF for the benefit of plane crews forced to bail out over water, the flying lifeboat is carried to the scene by a rescue plane and dropped easily down suspended from three parachutes. The men in the water, when they climb aboard, find an engine and fuel supply, sails and oars, and plenty of food, water and even medical stores. Close offshore and in the English Channel there are regular floating resthouses for watersoaked fliers; the airborne lifeboats are to take care of men adrift some distance at sea, are reported already to have saved many airmen's lives.

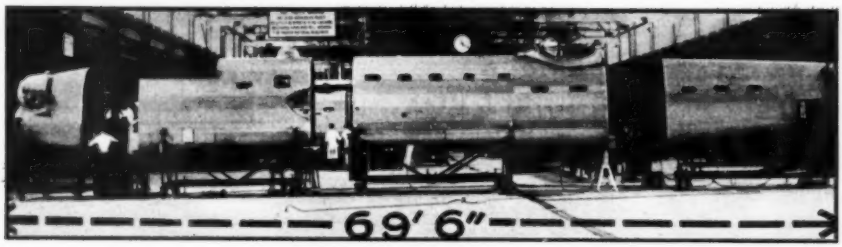


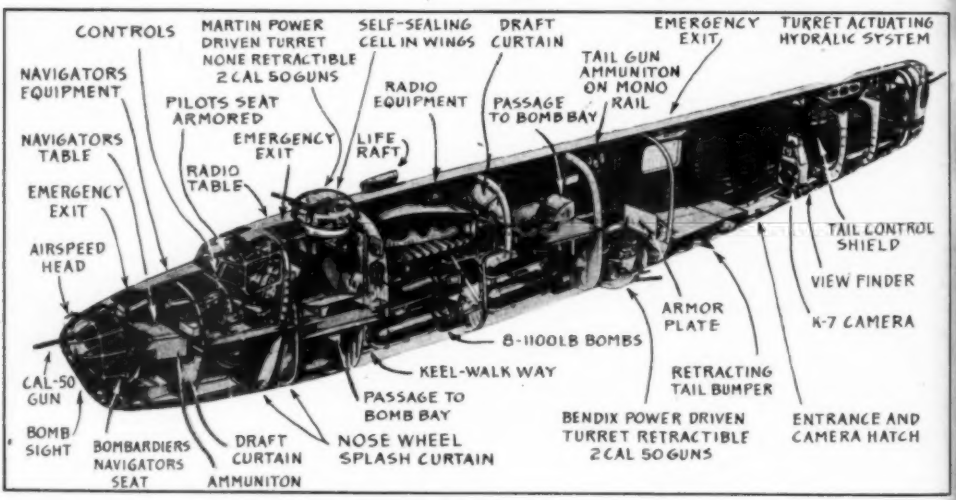
Addressed To Adolf

THE picture at *left* shows a sight which many a Nazi has seen from a distance, but not so many have lived to tell about; it is the open and loaded bomb bay of a big British bomber. The egg at left is a high-explosive bomb, and the bunched nest of them at the right are all incendiaries, which scatter to spread their fire as they fall.

Canadian Lancaster

TAKING shape *below* is one of the first Canadian-built Lancaster bombers to come off the assembly lines on its way to war, 16 months after the blueprint stage. Lancasters have a 69-foot length, 102-foot span, range of 3,000 miles with an eight-ton bomb load.

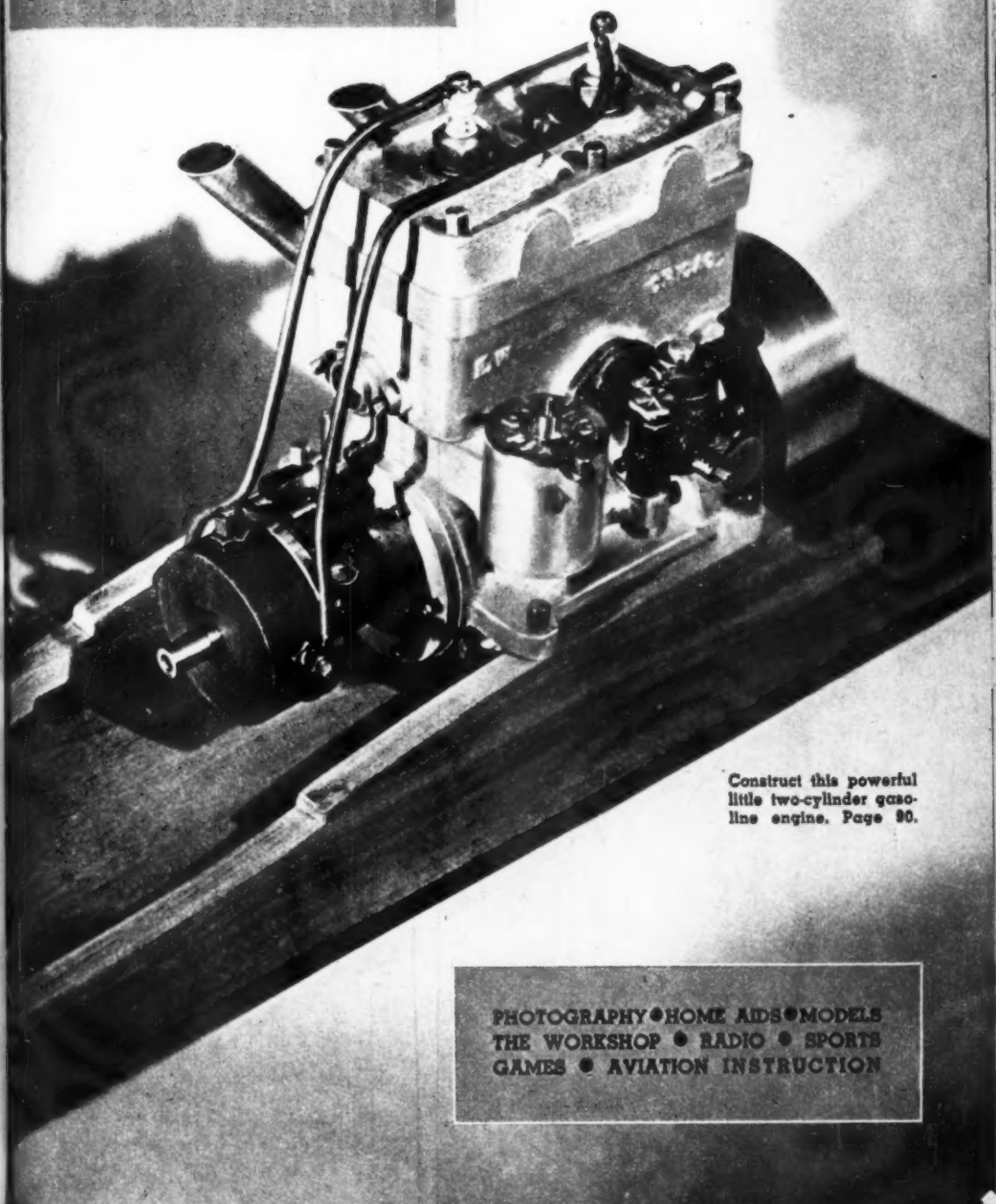




Inside A B-24

DIAGRAMMED *above* is the interior of a B-24 Liberator, minus wings and most of its gas tanks, but including its impressive stock of bombs. These long-range, powerful bombers, with their double tails, have given the Japs much trouble in the South Pacific.

CRAFTS AND HOBBIES



Construct this powerful little two-cylinder gasoline engine. Page 90.

PHOTOGRAPHY • HOME AIDS • MODELS
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STREAMLINE YOUR MODELS

Give a new "slant" to your subjects! You can lengthen the short ones and fatten the skinny ones just by using your enlarger.

by Roy Lester

UNFORTUNATELY, not every picture you take comes out as flattering to your subject as you'd desire. Although in many cases they may not be guilty of it themselves, your subjects often appear unpleasantly stout or stocky. This may be caused either by the angle from which the picture was taken or the lighting, but whether your model is really stout or not, you can still give her that sylph-like figure by streamlining her with your enlarger.

Streamlining is accomplished with the enlarger by bending the bromide paper on the enlarger easel to cause a slight elongation of the projected image. The paper should be bent only under that portion of the image which requires lengthening, usually the hips and waist of the model. The result, after making the exposure on this curved surface, is a taller and more slenderized appearance.

An excellent example of this stunt is shown

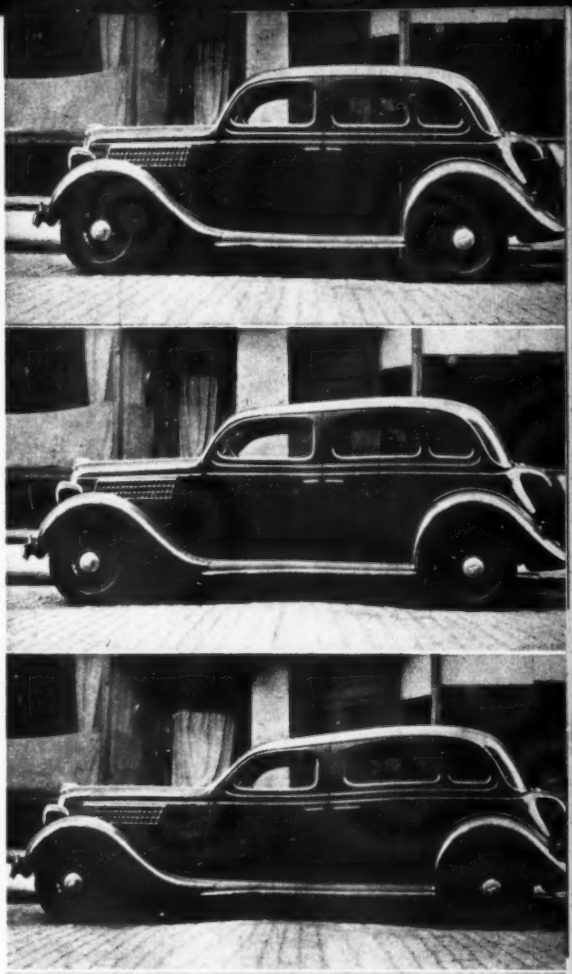
Here's "Schnappsy." He's streamlined at top.

This girl was "lengthened" for better effect.

on the bottom of page 84. In the first photo, which is a straight print, the low camera angle has resulted in the model photographing somewhat stockier than usual. In the second print, however, which was made from the same negative, the streamlining process has given her a tall, slender body which stands up impressively against the tall trees.

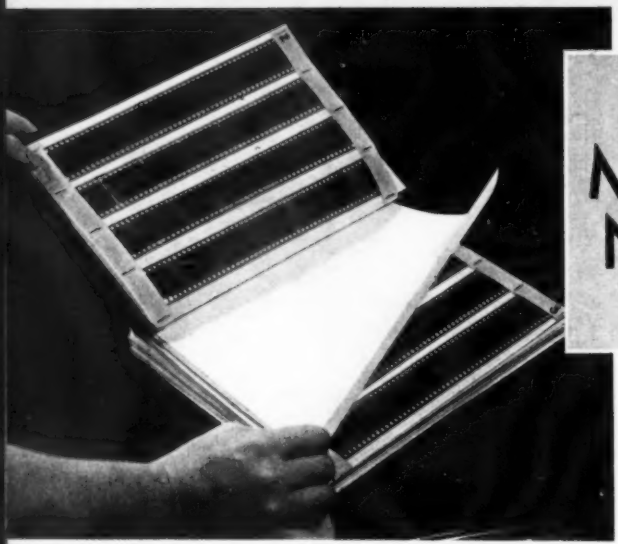
In bending the bromide paper under the enlarger, it is a good idea to practice first with a sheet of plain white writing paper until you get the correct degree of curvature needed before working with a sheet of sensitized paper. Take a large sheet of corrugated cardboard and use this on your easel to take the pins. On this, tack down a sheet of plain white paper; then use a second sheet of white paper over this for the bending tests.

By projecting your negative on this second sheet and bending it to various degrees of curvature, you can determine by sight the correct position and curve needed. Use eight pins along the edges of the paper to hold it in the proper curved position, and then mark guide lines on the underlying sheet of white paper to insure getting the same curve with subsequent sheets of bromide paper. Marks can be made on the guide sheet to show where the ends of the bromide paper should be and where the pins should be inserted. This sheet can be labeled with its corresponding negative number, degree of enlargement, [*Continued on page* 134]



Stretching your car in three easy steps (above).

Photo below shows how paper is pinned in easel. Interesting distortion is shown at right.



This 40-page negative album holds 1,120 frames.

FILE FOR MINIATURE NEGATIVES

by E. H. Harris

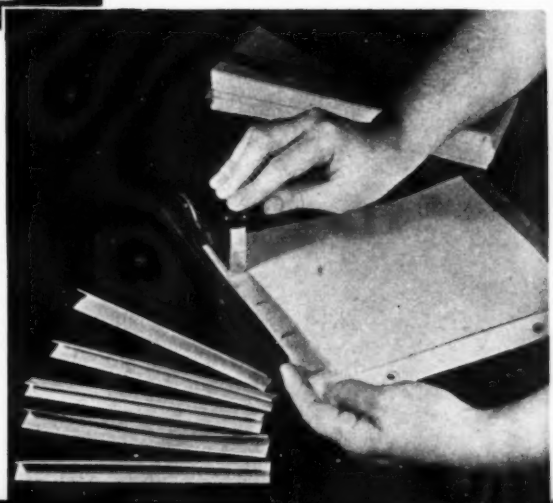
KEEPING 35-mm. negatives in roll form is O.K. until you have to start searching through a few dozen rolls to find one particular frame. That's when trouble, in the form of scratches and fingermarks, begins. Handling a length of 36-exposure roll film in a manner to avoid this difficulty is a pretty ticklish proposition, and it doesn't become easier when you try to get one particular frame into the enlarger for blowing-up purposes.

The fact remains, however, that 35-mm. film is still pretty popular with the camera-toting public, so the thing to do is to devise a convenient, fool-proof method of filing the tiny films whereby they will not be subject to abuse each time they are handled. Toward this end I have labored, until now I have an ideal 35-mm. negative filing system which permits me to see at a glance the contents of each negative without having to lay a hand on any until I am ready to enlarge them. Here's how it works!

The dime stores feature an inexpensive line of fancy, loose-leaf scrapbooks priced

Film slots are made from strips of wrapping paper folded as shown above. Two of them are needed for each page.

Place folded strips over the tops and bottoms of the pages and staple them in place to form film compartments.



Cut film in seven-frame lengths and slip their ends into slots formed.

A supplementary card file is used to index the negatives by subject.

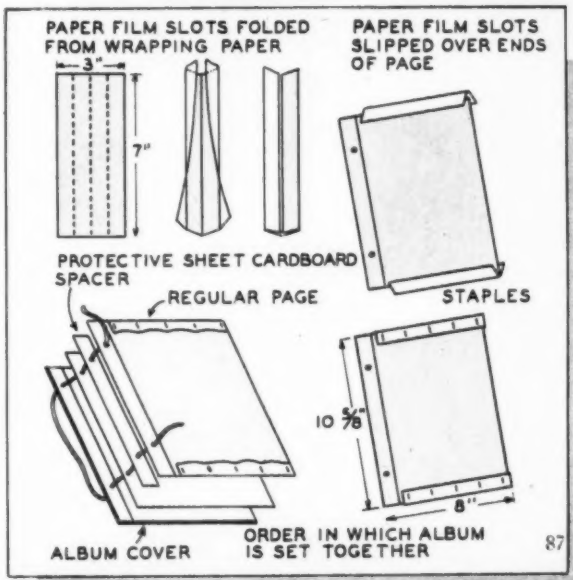
at ten cents. This size is just right for your album, its pages measuring about 8″x11″. These pages are adapted to hold short, seven-frame lengths of 35-mm. film in a flat, side-by-side position by cutting them down to 8″x10⅝″ and stapling folded strips of paper over their top and bottom ends in such a manner that four pairs of compartments, into which the film ends can be slipped, are provided on both sides of the page.

Make the paper folds of wrapping paper, measuring 3″x7″, as shown in the diagram. Fold the strips in half lengthwise and then fold each half inward toward the middle. This will form strong flaps with no weak edges exposed to wear.

Slip these folded flaps over the upper and lower ends of the scrapbook pages and staple them down as shown, spacing the staples about 1¾″ apart. Five staples should go in each flap, and in the spaces between them the strips of 35-mm. film can be slipped. Each page, so fitted, will hold eight strips of film, four on each side. The films should be inserted emulsion side down to protect them from accidental contact or friction.

To further protect them from rubbing against those on the facing pages, cut sheets of smooth, white stationery into 8″x10½″ rectangles, punch holes in their ends to correspond with those in the regular scrapbook pages, and insert one between each page in the album. This protective sheet will lie between the facing negatives.

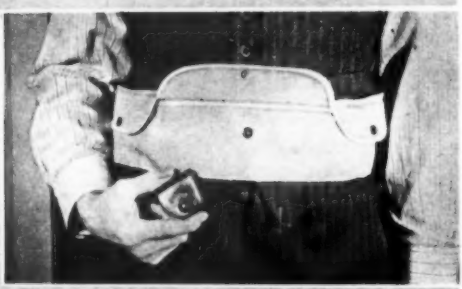
Since the pages when filled will be [*Continued on page* 134]



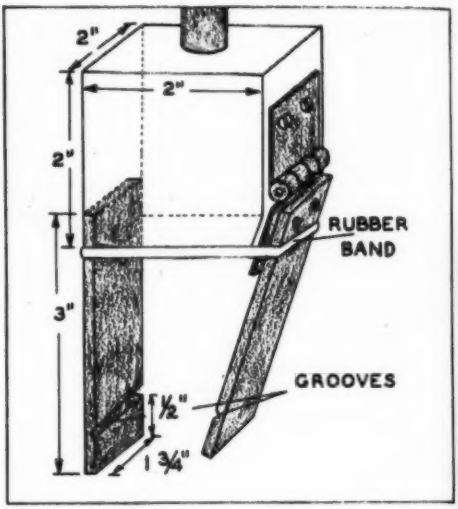
Make folds and assemble as shown.

PHOTO KINKS

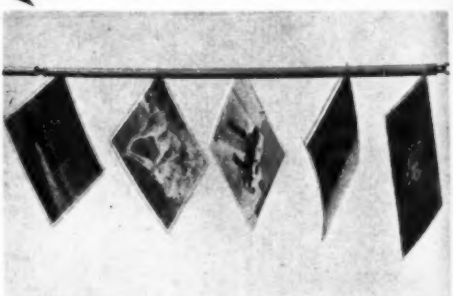
LANTERN-SLIDE PLATE CARRIER: This easily made carrier enables you to hold your lantern slides conveniently while processing. Make the holder of wood and the sides of bakelite.—George Lauer.



FOR HANGING NEGATIVES: The spring from a screen door makes an excellent "line" from which to hang sheet film. Slip a corner of each sheet between the coils of the spring.—Sgt. Leo H. Gille.



CAMERA ACCESSORY HOLDER: For photographers who never seem to have enough pockets for their equipment, a money belt is just the thing for lenses, filters, shades, etc.—George Carlson.



ENLARGING-PAPER MASK: Paint a series of white lines around the edges of the mask of the paper holder, and negatives with dark tone can be centered easily. Lacquer or enamel is best.—Walter E. Burton.

FILM WASHING

According to a recent discovery, *sea water* with a final wash of fresh water will reduce the time of removing hypo and permit a better non-fading image on films and prints. The salts in sea water dehydrate the gelatin in the film, making it possible for hypo to be washed out quickly. Wash film in sea water for one-half regular time and then in fresh water for five minutes.

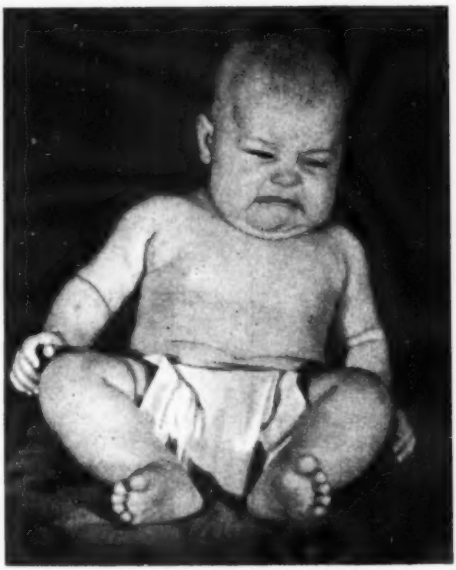
PHOTO CONTEST

FIRST PRIZE ($10.00): Manipulation!, by J. H. Ferrell, Detroit, Mich., taken with a miniature Speed Graphic on Super XX, 1/10 sec. at f-11. SECOND PRIZE ($5.00): As Shadows Lengthen, by H. J. Johnson, Chicago, Ill., taken with a Recomar on Panatomic film, 1/50 sec. at f-16. THIRD PRIZE ($4.00): The Angel, by Mabel Brees, Hillsboro, Ill., taken with a Voightlander Avus on Super XX. FOURTH PRIZE ($3.00): Waterfall, by Carl Mansfield.

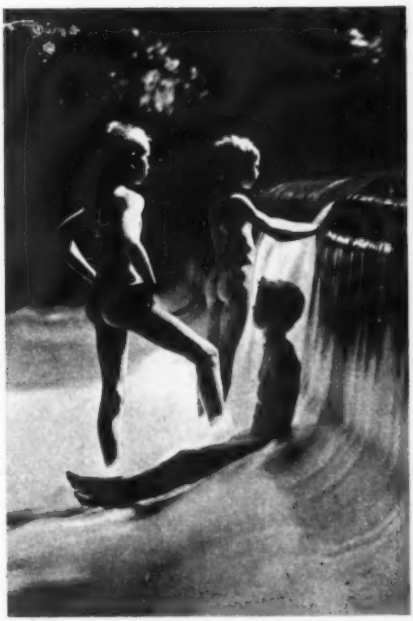
1st PRIZE

2nd PRIZE

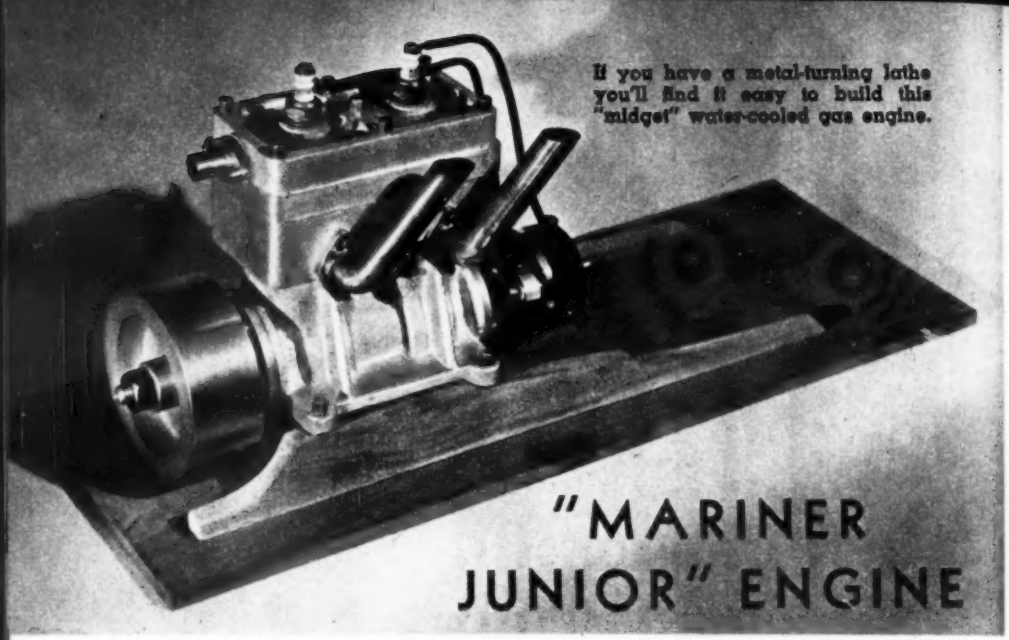
3rd PRIZE ↓



4th PRIZE →



Submit prints for this month's contest unmounted—no larger than 8x10 inches. With each print list your camera, film, lens opening and shutter speed, illumination, and developer. Write your full **NAME** and **ADDRESS** on the back of each print, and wrap securely with cardboard or corrugated stiffeners. If you want unused prints returned, **YOU MUST ENCLOSE RETURN POSTAGE.** (Published prints cannot be returned.) Address: Photography Editor, **MECHANIX ILLUSTRATED**, 1501 Broadway, New York 18, N. Y.



If you have a metal-turning lathe you'll find it easy to build this "midget" water-cooled gas engine.

"MARINER JUNIOR" ENGINE

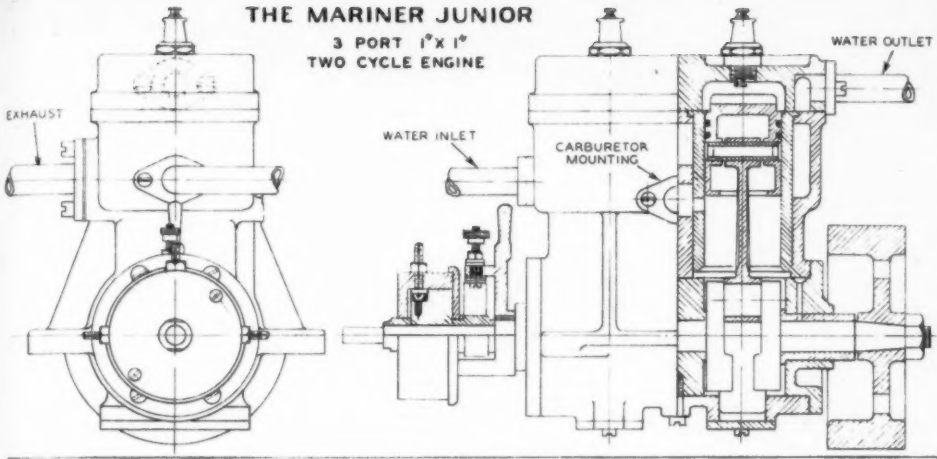
The rough castings as they come in kit form. If you have had experience you can turn them out yourself.

by C. W. Woodson

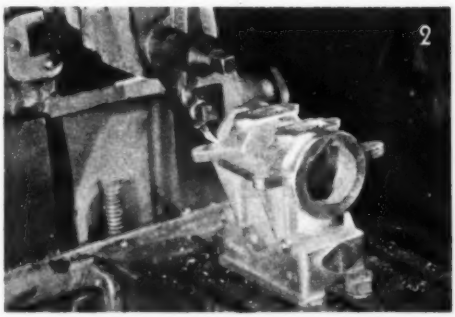
PART I

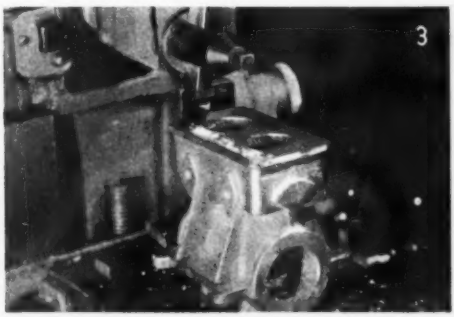
THE beginner, in the fascinating hobby of modelmaking, occasionally will find himself at sea when it comes to the building of a complicated working model such as the high-speed, two-cylinder gas engine shown in these photographs. There are always little fundamental things he wants to know about when tackling a new job, and all too often these are the most annoying and difficult to find out.

Frequently, too, when a modelmaker becomes well enough acquainted with his hobby to write about the building of an engine like this, he is apt to forget or overlook some of the fundamental things he learned in his own apprentice days and take it for granted that the beginner knows as much about the various problems involved as he does himself. To guard against this possibility, in outlining the

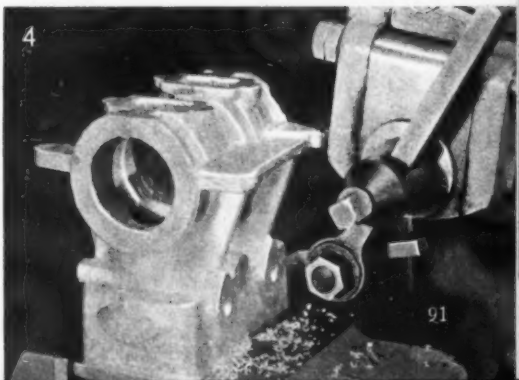


NO.	NAME OF PART	NO.	NAME OF PART	NO.	NAME OF PART
1	CYLINDER BLOCK	13	CRANK CASE BEARING PLATES	NO.	TIMER—DISTRIBUTOR
2	CYLINDER HEAD	14	PIPE FLANGE	1	TIMER
3	CYLINDER SLEEVE	15	CONNECTING ROD	2	CAM
4	PISTON	16	FLYWHEEL	3	DISTRIBUTOR CAP
5	PISTON RING		SPARK PLUGS - - - - - - - - - - 2 REQ	4	DISTRIBUTOR PLATE
6	WRIST PIN		10-32 X 1 FIL. HEAD SCREWS - 6 - REQ	5	ROTOR
7	WRIST PIN PLUG		5-40 X 5/16" FIL HEAD SCREWS - 30 REQ	6	NUT
8	CENTER BEARING		5-40 X 5 8 FIL HEAD SCREWS - 3 REQ		STEEL CIRCUIT BREAKER WASHERS - 4 R
9	CRANK SHAFT ST STOCK		5/16"-24 HEX. NUT - - - - - - - - - 1 REQ		FIBRE CIRCUIT BREAKER WASHERS - 4 R
10	COUNTERWEIGHTS				CIRCUIT BREAKER TERMINALS -- 2 REQ
11	CRANK CASE BOTTOM PLATES				2-56 X 3/16" FLAT HEAD SCREWS - 3 R
12	MAIN BEARING				5-40 X 5/8" BRASS SCREWS - - 3 REQ

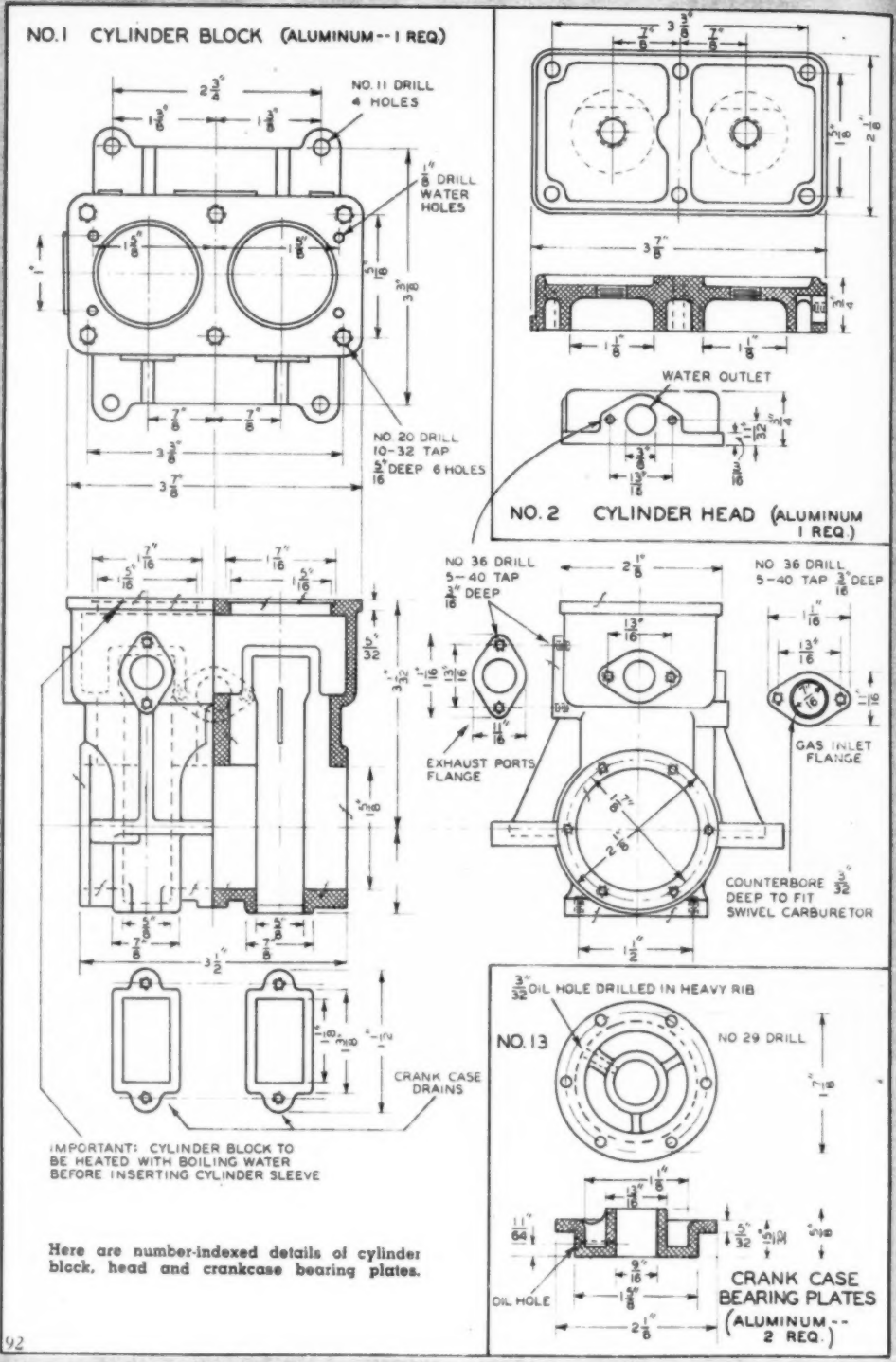




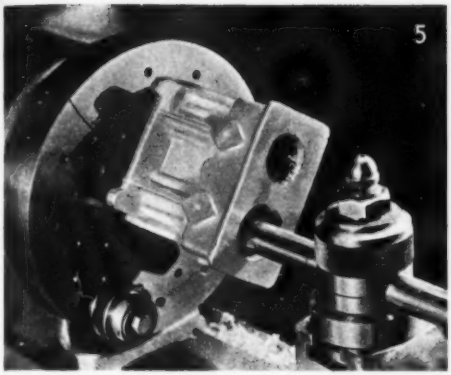
Drawing at top shows side and end views of the engine, with chart of parts below. You will find the numbers corresponding to the parts on the individual diagrams as you progress. Save this key for reference later. Photos show start of cylinder block machining.

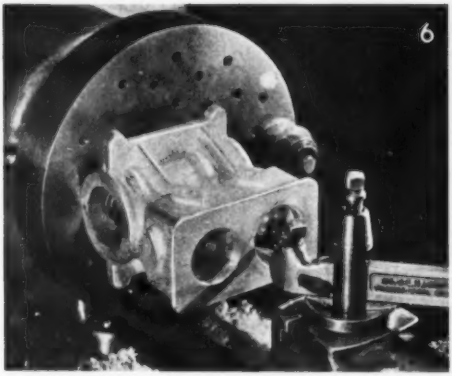


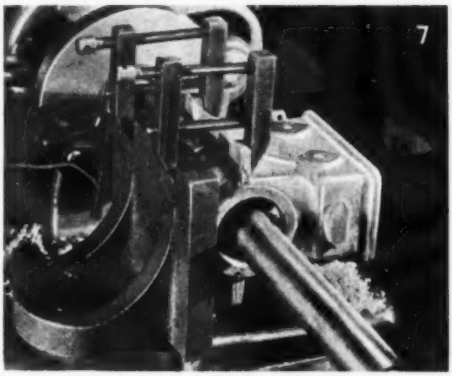
construction of this little engine, and to be of greater help to the novice, each operation in machining a set of castings will be described in detail and illustrated with line drawings and many photographs making it possible for the less experienced mechanic to do a better

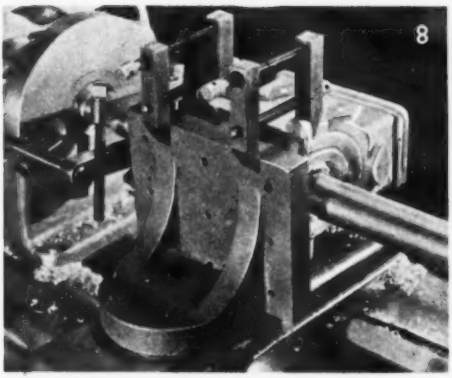

NO.1 CYLINDER BLOCK (ALUMINUM--1 REQ.)
NO. 11 DRILL 4 HOLES
1/8" DRILL WATER HOLES
NO. 20 DRILL 10-32 TAP 5/16" DEEP 6 HOLES
CRANK CASE DRAINS
IMPORTANT: CYLINDER BLOCK TO BE HEATED WITH BOILING WATER BEFORE INSERTING CYLINDER SLEEVE
WATER OUTLET
NO. 2 CYLINDER HEAD (ALUMINUM 1 REQ.)
NO 36 DRILL 5-40 TAP 3/16" DEEP
NO 36 DRILL 5-40 TAP 3/16" DEEP
EXHAUST PORTS FLANGE
GAS INLET FLANGE
COUNTERBORE 3/32" DEEP TO FIT SWIVEL CARBURETOR
3/32" OIL HOLE DRILLED IN HEAVY RIB
NO.13
NO 29 DRILL
OIL HOLE
CRANK CASE BEARING PLATES (ALUMINUM-- 2 REQ.)

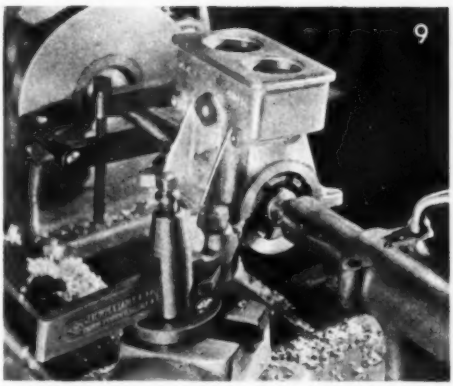
Here are number-indexed details of cylinder block, head and crankcase bearing plates.

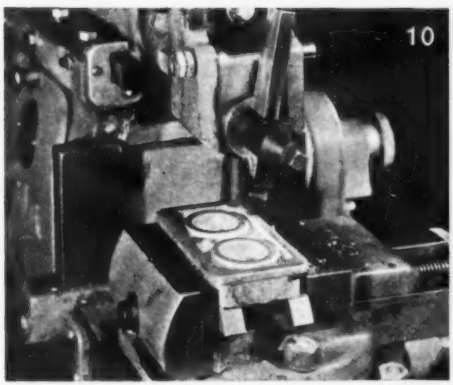








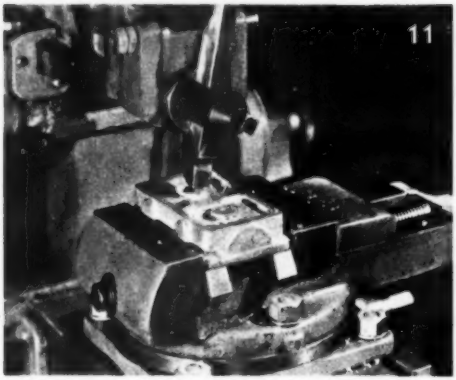


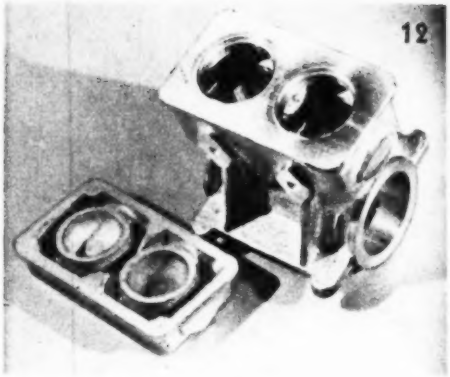


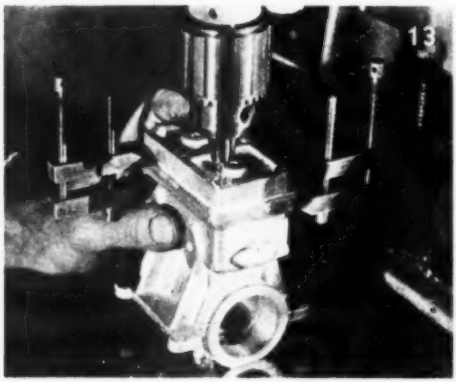
Step-by-step machining operations are clearly shown in the brilliant photographs accompanying this article. Above you see the cylinder block being machined, first while held on the faceplate, then in vise on bed.

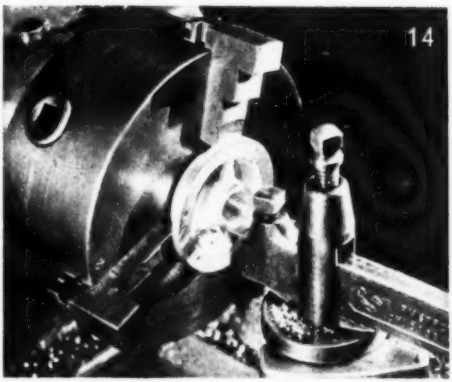
job and produce a motor which will perform to his satisfaction.

This little two-cycle water-cooled engine was designed for high speed and consistent performance where a light but powerful motor is needed. It has a bore of 1⅛" and a stroke of 1", giving a displacement of 30 cc. and developing ½ H.P. at 7,500 r.p.m. It can be built in several different ways: with a rotary valve and supercharger effect which will require gears, or in the simpler manner shown here. The original blueprints were from the board of





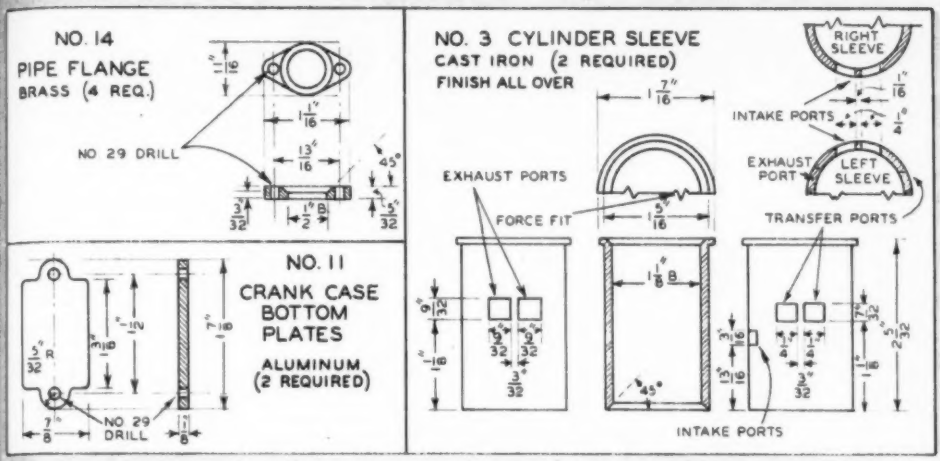




Block and head are shown in (12) after being removed from the lathe. Bolt holes are then drilled, with the two parts clamped accurately together. Photo 14 shows crankcase bearing plate being trimmed down.

Mr. E. A. Wall of Chicago, who is perhaps the nation's foremost designer of model gas engines and is well known abroad for his many contributions in this field. After years of experimenting Mr. Wall was well rewarded for his efforts when he designed this little two cycler which he promptly named the "Duplex Mariner" in honor of his friends the model speedboat fans, many of whom have since built the little power plant for installation in their frail but speedy hydroplanes. The records these men have obtained, using this motor with its supercharger effect, have been amazing and the long, hard runs it has been given on the test bench have proved beyond a doubt that it is built to take it and can be used for many other purposes as well.

The big majority of Mr. Wall's engines have been of the four-cycle type, but here he has digressed from his usual practice and turned to our old friend the two-cycle marine motor, so popular in the boating days at the turn of the century before the automobile came into its own. This design has a number of advantages over any other and when skillfully adjusted is probably the finest type of engine ever built. As most of us know, the two-cycle engine gives an impulse every revolution, completing the cycle of events—suction, compression, explosion and exhaust—in two strokes of the piston instead of four, giving a greater uniformity of speed and developing 60 to 80 per cent more power than the four-cycle engine of the same size. Instead of having valves as in the four-stroke type it has exhaust and intake ports cored in the side of the cylinder walls. These ports are uncovered by the piston as it moves up and down. During the upward stroke gas is sucked into the crankcase through the carburetor while in the downward or power stroke this fuel, for the succeeding charge, is partially compressed in the crankcase. When the piston nears the end of the downward stroke it uncovers the exhaust port, permitting the burned gases to escape. Immediately after, the intake port is

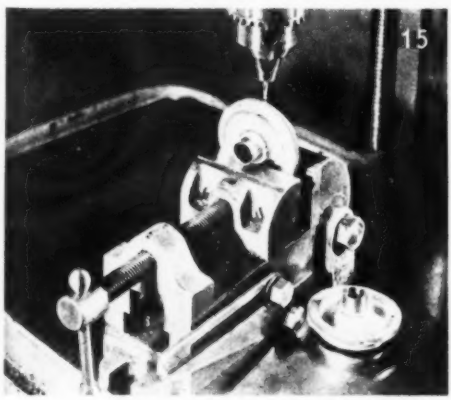


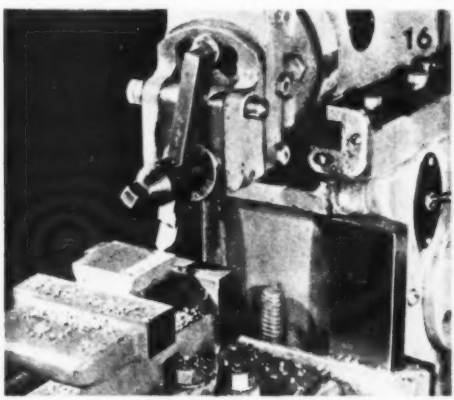
More simple to finish to size are the parts shown above. Particular care, however, must be taken with sleeves.

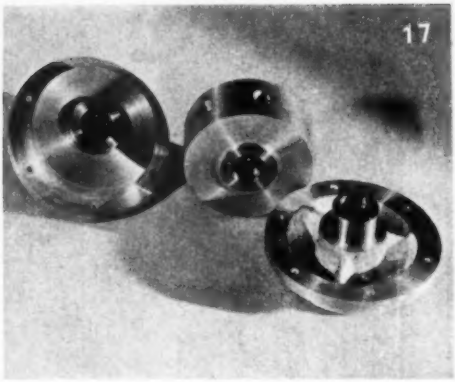
uncovered and the partially compressed charge from the crankcase is shot into the cylinder. On the return stroke the intake and exhaust ports are closed and the gases are compressed for the following power stroke.

The building of a motor of this type presents several problems, by no means the least of which are the patterns. These must be made before castings can be poured, and this is a job for the professional patternmaker. While a number of the patterns are quite simple and easy to make there are several which require a thorough knowledge of the work as well as some idea of what the foundryman, who is to make the castings, will expect in the way both patterns and core boxes are built. The most difficult of all the patterns for this little job will be the combined cylinder block and crankcase base with its intricate core work to obtain proper wall thickness, clearance for the connecting rods, provision for intake and exhaust ports, openings for the main bearings, base plates and cylinder liners, and the necessary water jackets to keep the motor cool. Unless one is well experienced in pattern making it will be best to build the little motor from a set of purchased castings, which was the course followed in constructing the engine shown in the photographs. The complete set of castings is shown in Photo 1. They are made up from various metals best suited to the purpose. A hard aluminum alloy, employed wherever possible for lightness, was used in making up the main cylinder-block casting, the cylinder head, crankcase bearing plates, center main bearing, the carburetor

Below: Drilling oil holes in bearing plates, and starting work on center bearing.





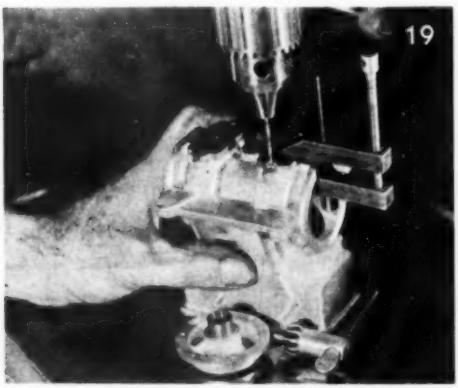


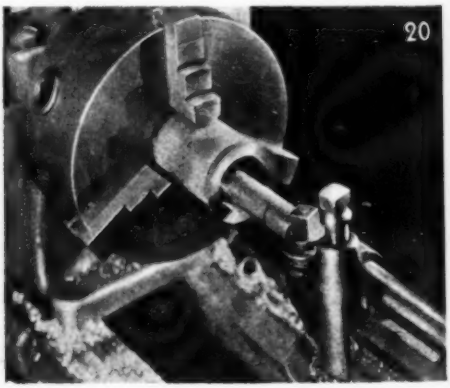
Left: Center bearing and two end, or crankcase bearings. Right: Drilling one of the latter for the screws which will hold it. Photos at bottom of page illustrate drilling of bottom plates, beginning of cylinder sleeve machining.

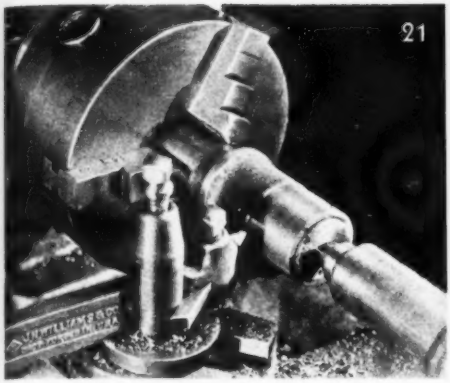
shell and crankcase bottom plates. The pistons are of Lynite which is light and hard and the best material for this particular job. The connecting rods are of bronze, as are the main bearings, the crankshaft counterweights, timer parts, pipe flanges and several of the parts for the carburetor. The flywheel and cylinder liners are of hard cast nickel iron. There will be other items needed which can be made up from bar stock, such as the crankshaft, piston pins, timer cam, and a number of the carburetor parts as well.

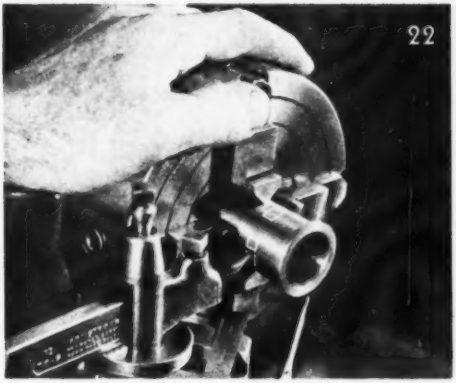
Machining The Parts

The drawings should be given much thought and study and also carefully compared with the individual castings until each part as well as the working of the motor as a whole is thoroughly understood. With this accomplished, work can be started on the machining of the various parts. As the whole motor is built around the main cylinder block and crankcase casting this seems to be the logical starting place. The casting is cleaned up, where necessary, with a file to insure its setting perfectly level and strapped to the table of the shaper (Photo 2) where the bottom is machined smooth at the same time, carefully following the dimensions in the drawings. This gives an accurate base from which measurements can be made in machining the top of the cylinder block (Photo 3), it being again bolted and strapped firmly to the table where a number of light cuts are taken to obtain the smooth surface needed for a compression-tight joint when mounting the cylinder head in place. It is then set on a parallel block, held in the shaper vise (Photo 4), and the exhaust pipe and carburetor flange mounts faced smooth. The cylinder block is then mounted on the face plate of the lathe and the holes for the cylinder liners bored as in Photo 5, great care being taken to get







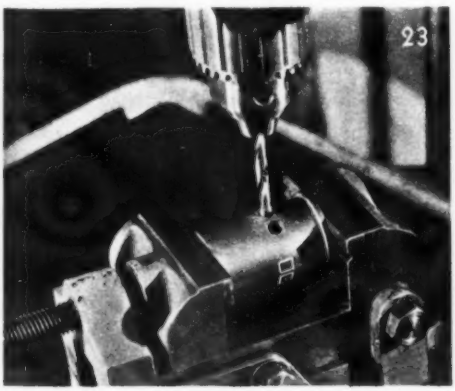


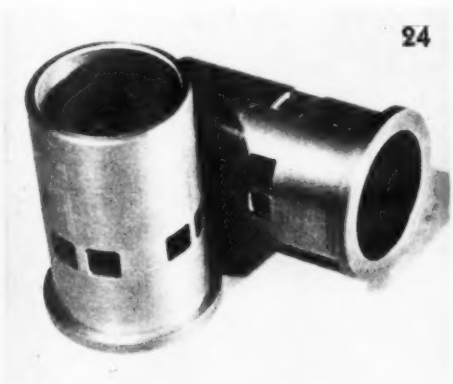
Sleeve is smoothed out, marked and drilled for the exhaust ports. This work must be done very accurately.

these located accurately and bored to exact size. The recess around each cylinder hole, to receive the flange on top of the cylinder liners, is cut after the hole is bored but before shifting the casting on the faceplate. This insures the recess being concentric with the hole. The cutting of this recess is shown in Photo 6 where a specially ground tool bit is used in the regular tool holder instead of attempting to make this cut with a boring bar.

The holes for the main bearing plates are bored with a special boring bar held between centers, while the work is mounted on an angle plate fastened to the cross slide of the lathe in place of the compound rest (Photos 7 and 8). The homemade boring bar is simply a 12″ length of cold rolled steel 1″ in diameter center drilled on each end and a ¼″ hole drilled through its middle. This hole is squared up with a small file to receive a regular ¼″ cutter bit which is held securely in place with a heavy setscrew. The cylinder casting is mounted on the angle plate with its center line at exactly lathe-center height. The cross-slide feed screw can be used to center the casting horizontally. The cutter in the bar is adjusted and a very light cut taken on the end of the crankcase, where careful measurements must be made to insure the hole being started in its proper location. When adjusted accurately in place and with the lathe running at high speed, the work is brought to the cutter by the lathe carriage with a very fine power feed for the full length of the casting. After taking the first through cut in the three main bearing holes, the tool bit in the boring bar is driven out several thousandths and the operations repeated until the holes for the bearing plates are brought to exact size. With this accomplished the casting should be mounted on an expanding mandrel as in Photo 9 where the crankcase ends are turned smooth and at right angles to the bearing holes.

[*Continued on page* 132]



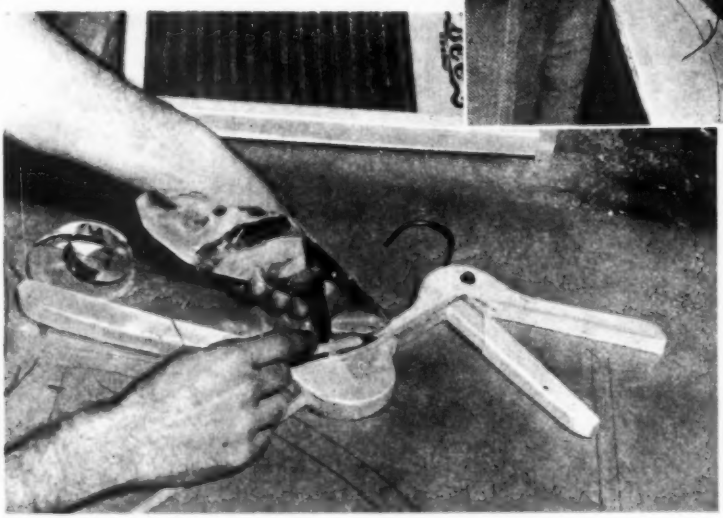


THINK TWICE

THERE really isn't any such thing as "junk." It depends entirely upon how you look at the situation. Many items which you ordinarily would throw out with the spring or fall cleanup, can, with a little imagination and skill, be turned into works of art to decorate your home. Just to show what we mean, we ask you to consider the lowly coat hanger. A little carving here, a few pieces of tin can stuck there, a little paint over all, and presto!

This new kind of bird, a specimen of which is shown in the photo above, is called the Coat-hanger Bird. It will look well on the table of your modern home.

An ordinary tin can, properly fluted, will make the bird's wings. Cut the tin carefully, getting rid of any projecting slivers and rough edges with a file.

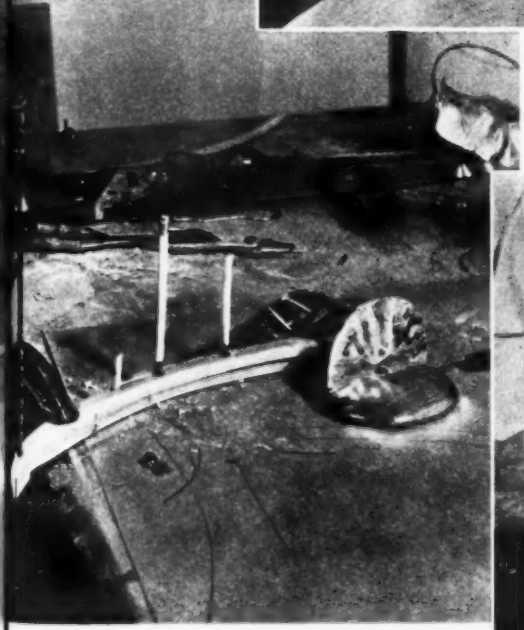


Two coat hangers will make one bird. Set the wings in the sides of the body. Use a dowel for the leg and a child's washboard for the base. Paint it with colored enamel.

BEFORE YOU THROW IT OUT

Here is a nifty ornament for your bachelor apartment. Related to the previous specimen, this one is the Coat-hanger Fish.

Two wooden hangers are glued together after tin fins, fluted with a curling iron, are placed between them. Make secure with dowels.



Cut a slit for the mouth and use costume jewelry for eyes. Set in base as shown and paint with enamel.

In the photos above are shown a handy pipe rack and a decorative book shelf made of a large drawer from a discarded hardwood cabinet.

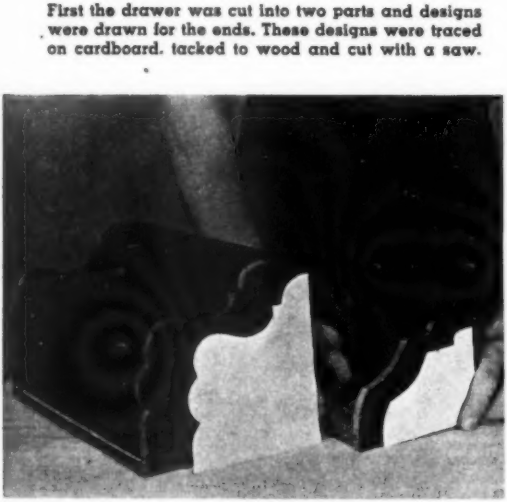
DISCARDED FURNITURE DRAWERS

make useful articles

MANY old pieces of furniture you have lying around your attic or cellar can be converted, without too much trouble, into smart, modern pieces. This subject of remodeling furniture has been discussed thoroughly in recent issues of MI, but here's a new angle to test your ingenuity and skill as a craftsman.

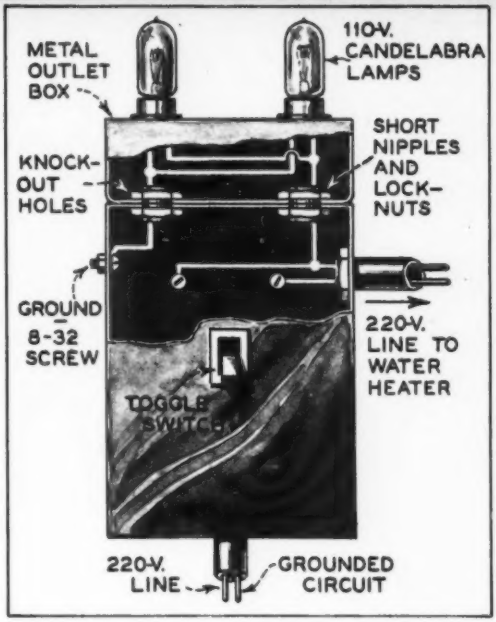
Many of these old pieces have neat little drawers; cabinets, night tables, sewing tables and certain types of end tables have them, and you will discover that in most cases they are made of hardwood with a pleasing grain. They are exceptionally well-constructed, too, having corners either dovetailed or pegged and glued. By sawing these drawers in sections and adding a few flourishes here and there as shown, you can construct book ends, smokers' accessories, desk pieces, tie racks, book shelves and numerous other simple and serviceable articles. Finish them by sanding with fine sandpaper and then give them a coat of shellac (two parts alcohol and one part shellac). When this is dry, sand lightly once more and polish with wax. The pipe rack and book shelf illustrated here were made in this manner. In the pipe rack an extra piece of wood was used to hold the pipes.

First the drawer was cut into two parts and designs were drawn for the ends. These designs were traced on cardboard, tacked to wood and cut with a saw.



PILOT LIGHT FOR WATER HEATER

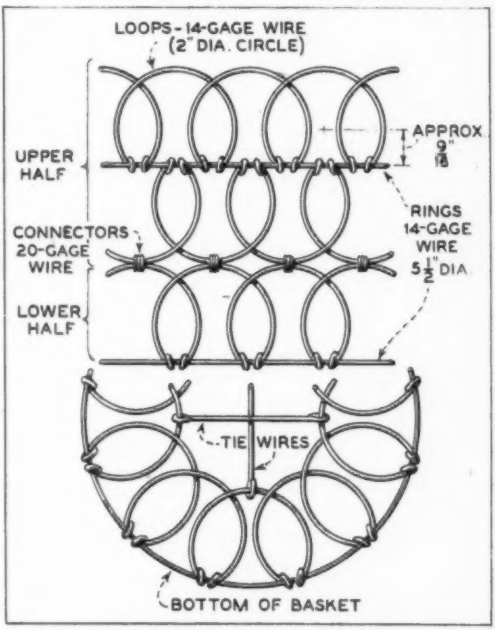
MAYBE you're one of those people who are accustomed to dash out of the house in a hurry and to remember when halfway down the street that they forgot to turn off their electric water heater! Of course, if you have one of the automatics, you don't have this trouble, but a great many of us have the kind with the manually operated switch and have to rely on our memories. This idea will prove quite a help. Install two small lamps connected in parallel on top of your switch box so they'll burn when the switch is on. You'll need about 6″ of wire, a standard double-outlet with metal box, an 8-32 screw with nut and the small 110-volt lamps, red preferred. Two lamps are used in case one burns out. If you can't buy red bulbs get white ones and dip them in red paint.

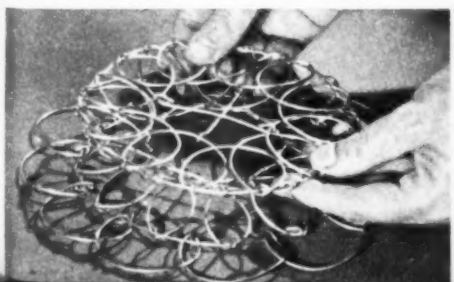


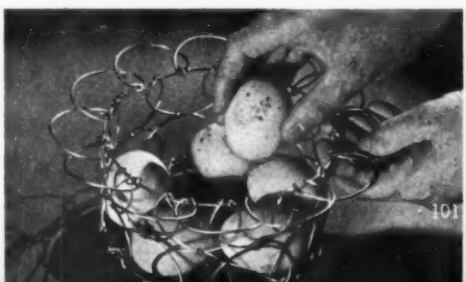
WIRE BASKET TABLE PAD

HERE'S a novelty item the amateur craftsman can turn out in jig time and all he needs are some lengths of wire and a good wire-cutting pliers. It is a wire basket which can be folded and used as a pad for supporting hot pans, dishes and even your electric iron.

The basket is composed of sixty-two pieces of wire, most of which are curved. The model shown in the photographs and drawing is 5½″ in diameter and 4″ in depth. It consists of forty-eight loops, two 5½″ rings, two straight pieces of No. 14 cadmium-plated or galvanized-iron wire, and a dozen connectors for the sides made of No. 20 wire. The diagram shows how the loops, rings and connectors are assembled to form the basket. On each 5½″ ring twenty-four loops are interlaced as shown. Two such assemblies united by the connectors are required. The bottom consists of a row of loops folded inward and secured by two straight lengths of wire crossing in the center.





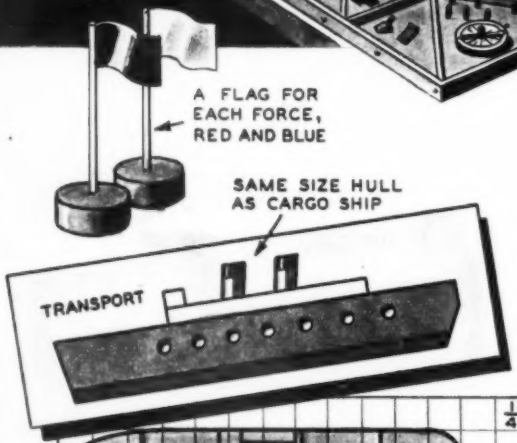


INVASION!
AN EXCITING WAR GAME

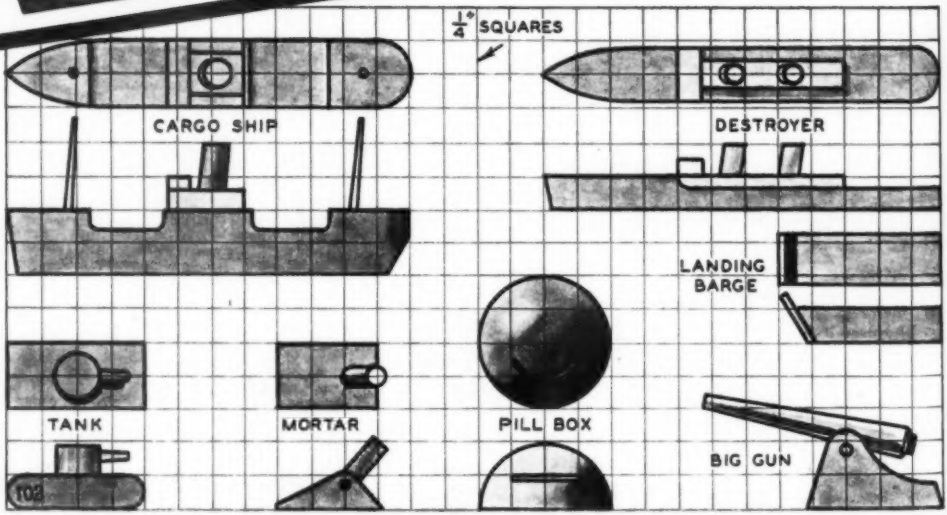
by Hi Sibley

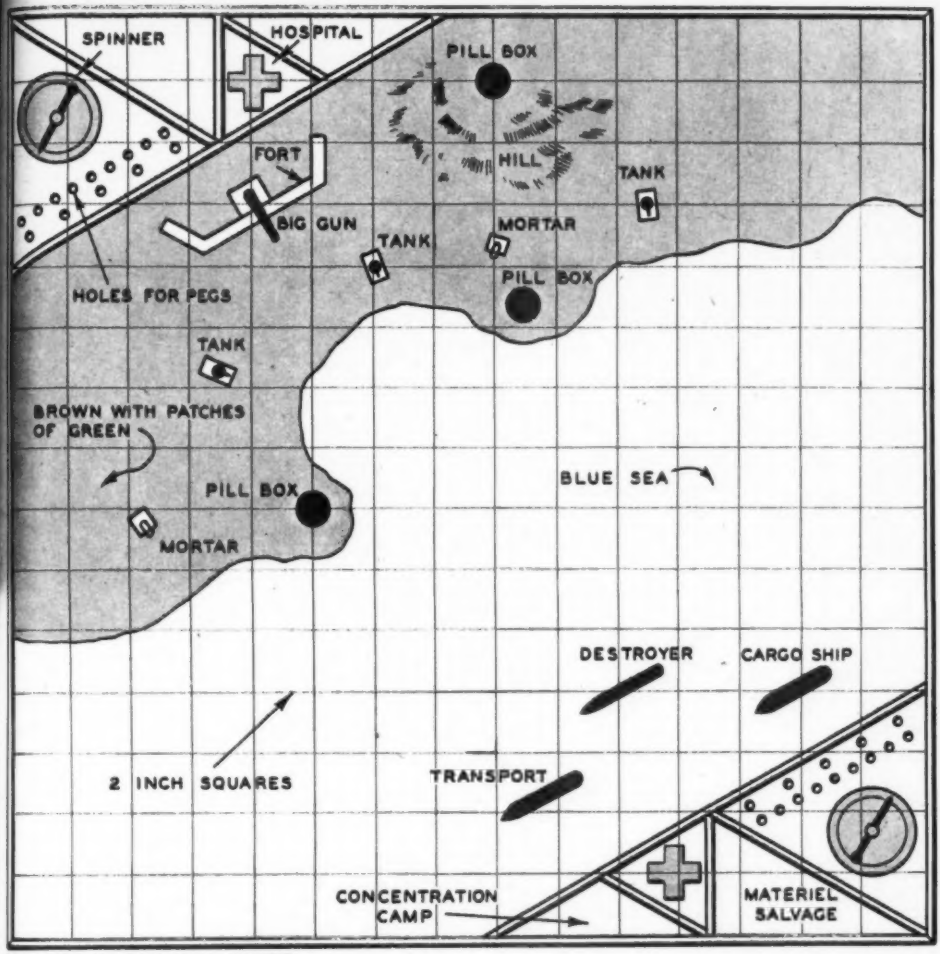
HERE is a modern war game that will provide its maker with many an evening of fascinating entertainment! You can be your own armchair military strategist and direct the movements of your forces as though you were a real brass hat with a plan of actual offense or defense operations spread out before you.

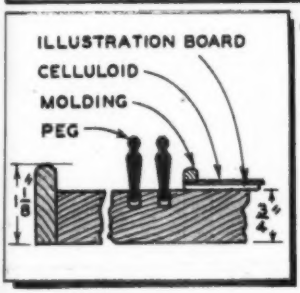
With the Blue Force defending its coast and

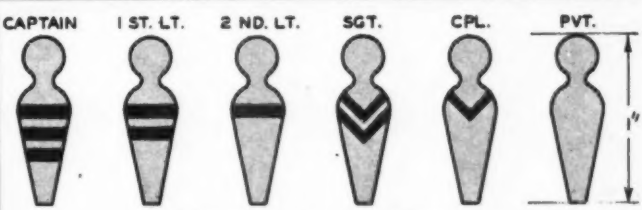


Follow squared pattern for ships, guns, etc.







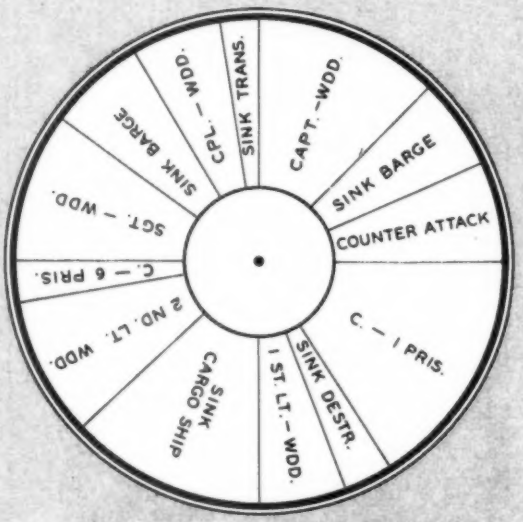


WOODEN PEGS: PAINTED OLIVE DRAB WITH RED AND BLUE BANDS

Paint design (above) on illustration board and fasten to table top.

the Red Force attempting to gain a beach head, this invasion game presents many exciting situations, with ships being sunk, tanks and guns captured and soldiers wounded. But none gets killed, you will note. The force which first captures the other's soldiers, except those in hospital, wins the battle. If the Red Force captures all the tanks, guns, and pillboxes, even though the Blues still have men in the field, the Reds win, the opposing soldiers automatically becoming prisoners. On the other hand, if the Blues sink all the

DIAL FOR INVASION FORCE



DIAL FOR DEFENSE FORCE

Red ships and barges, they are victors, regardless of how many men the Reds have in action.

Each side is provided with a dial and spinner. When the pointer stops between the two lines, the player moves accordingly. Note that the largest gains are indicated in the narrowest sectors, as for instance, capturing the fort, or on the other side, sinking the transport. When a man is wounded, the player must put one of his own men in the hospital for the remainder of the game. In case the pointer stops over "counter-attack," the player must return to the board such men as he last captured on a previous move. Different rules, however, may be made up by the players before the start of the game, if they prefer.

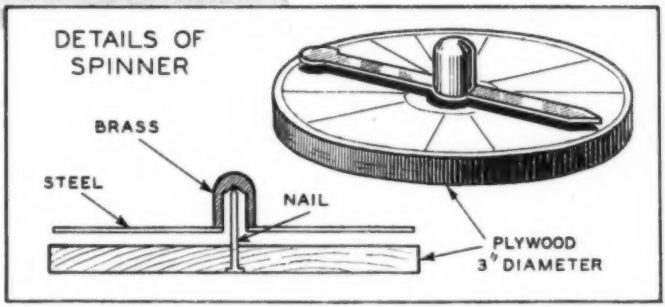
The board is just the size of a card-table top, made of common ¾" pine and bound with a strip around the edges having mitered corners. On illustration board, tacked to the baseboard, paint the sea blue, the land brown with patches of green here and there for trees, perhaps a stream or two and the fort and hill also. Crayons will do instead of water colors, although they will run a little if shellacked or varnished. It would be better to protect them with celluloid.

Compartments are made for a concentration camp, a hospital, salvage dump for captured materiel, [*Continued on page* 136]

Dials (left) can be cut out and used as they are or can be copied to a larger size. Mount them on separate wooden or heavy cardboard disks, shown (below).

ABBREVIATIONS

C. ----- CAPTURE
WDD. --- WOUNDED
PRIS. --- PRISONER
DEST. --- DESTROYER
CAPT. --- CAPTAIN
LT. ----- LIEUTENANT
SGT. ---- SERGEANT
CPL. ---- CORPORAL



MI MODELMAKERS

Several Mechanix Illustrated staff members indulge in modelmaking as a hobby, and are very clever about it. Recent work of two of them is shown here, and we think you'll agree that it's pretty neat. Al Allard, MI Art Director, built a scale model of his home, and Fred Ripperda, MI staff artist, completed a "dashboard" for one of his model steam engines.

House That Allard Built

THIS model was built in 60 working hours for the purpose of studying a wing addition to Al's home. Scaled ¼" to the foot, the walls are constructed of 4-ply cardboard. Architectural details have been worked out in varying thicknesses of paper and cardboard.

Shingles were cut in strips and notched with a sharp knife. Overlapped in rows, they create the effect of individual hand laid shingles. Bricks in chimney and fieldstone on wing are separate pieces of thin cardboard over which a coating of glue size and whiting is painted to resemble stone. All wall sections are completed, including tinting, before assembly to speed up the work.

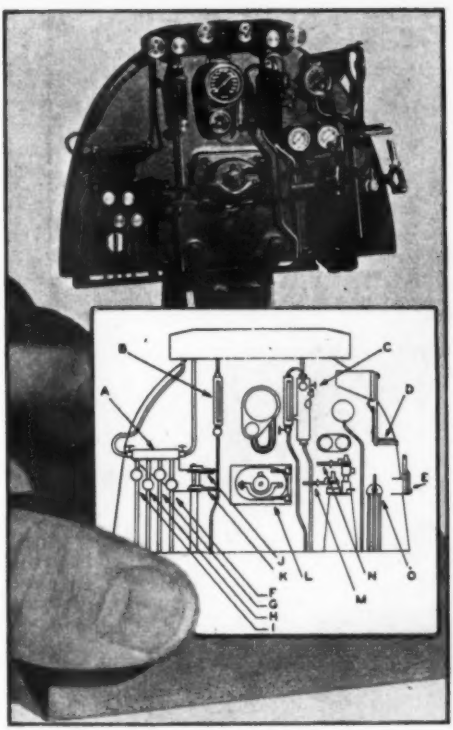
Shrubbery is made from rubber sponge held in position by strands of copper wire. Grass is cotton velour cloth tinted green and sealed in position with rubber cement.

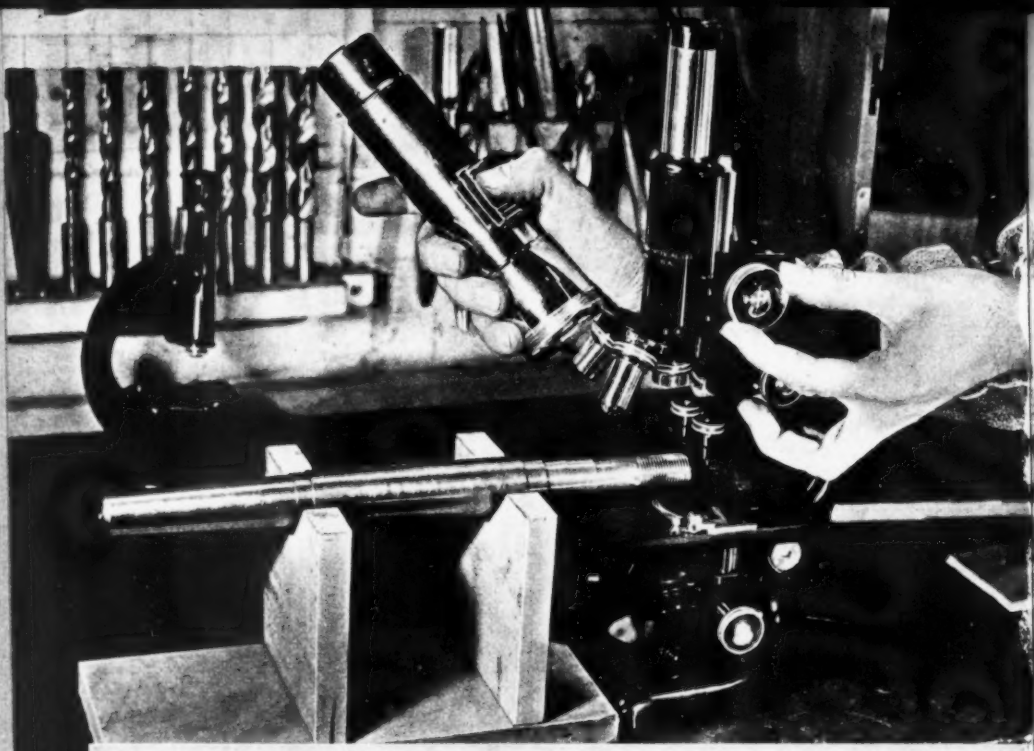
Locomotive Cab Fittings

IN SPITE of its tiny size, as indicated by comparison with the thumb in the photograph, every lever and other detail of this model oil-burning locomotive "dashboard" is a correct replica of the real thing.

The scale is ¼" to the foot. Gauge dials are photostats reduced to proper size. Parts are:

(A) *Manifold;* (B) *Water Gauge;* (C) *Water Column and Gauge;* (D) *Throttle Lever;* (E) *Power Reverse Lever;* (F) *Tank Heater Pipe;* (G) *Steam Line to Oil Heater;* (H) *Steam Line for Blowback;* (I) *Steam Line to Oil Burner;* (J) *Oil Cock Regulator;* (K) *Firepan Damper Regulator;* (L) *Fire Door;* (M) *Automatic Brake Valve;* (N) *Independent Engine Brake Valve;* (O) *Pneumatic Sander Operating Valve.*





THE MICROSCOPE: SHOP HELPER

If you have a home workshop or plant engaged in war production, put overalls on your microscope and let it give you a hand.

by Walter E. Burton

THE compound microscope, primarily a laboratory instrument, has a definite place in the modern shop and can render valuable assistance in countless ways.

Most shop uses for a microscope involve rather low magnifications, say from 10X to 100X. The ideal instrument for many jobs is a low-power binocular microscope giving stereoscopic vision, and almost equally effective is the ordinary compound microscope equipped with low-power objectives and oculars. A useful magnification (13X) is given by a 40-mm. (2.6X) objective and a 5X eyepiece in a standard tube. The low power of many amateur instruments is a distinct advantage.

One of the commonest applications of the microscope in the shop is the examination of metal surfaces. A piece of work that has been subjected to milling, grinding, turning, planing, or other operations may be placed under the microscope, [*Continued on page* 136]

GRINDING-WHEEL PELLETS:

MAGNIFICATION:
APPROXIMATELY 100 TIMES

ROUND PELLETS = CARBON STEEL
"POTATO-SHAPED" PELLETS
= HIGH-SPEED STEEL ALLOY
IRREGULAR PARTICLES
= STEEL SHAVINGS AND GRINDING-WHEEL GRIT

LATHE TOOLS FROM OLD FILES

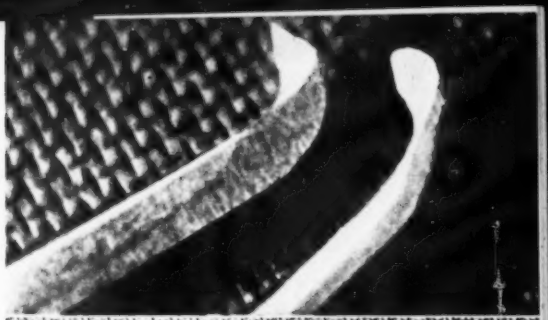
A little grinding, shaping and tempering will do the job.

by Gordon Douglas

WHEN your three-cornered, square and flat files become worn and have outlived their original purpose, don't throw them away. They are made from the best of steel, and with a little manipulation they can be converted into first-class tools for your metal-turning lathe.

Top, end and side views of three of the most-used tools are shown sketched in Fig. 1. A is a round-nosed right-hand tool for straight turning operations, and when properly shaped, it is free-cutting and gives a good finish. B is a right-hand facing tool and C a cut-off tool. D and E in Fig. 2 are boring tools, the making of which will be described later.

As there are a great many inexpensive books on tool grinding available, it will not be necessary to go into that subject here. The various angles of clearance, side rake, etc., vary considerably with different materials, and usually a little experimenting will show which are best for [*Continued on page* 134]



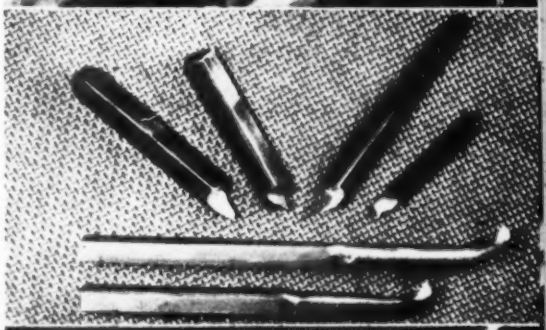
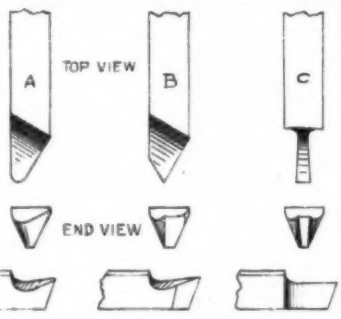


FIG 1.



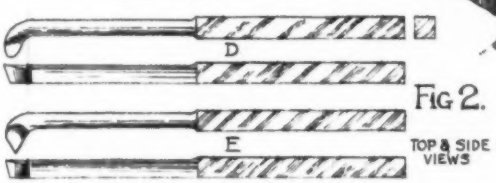


FIG 2.

TOP & SIDE VIEWS

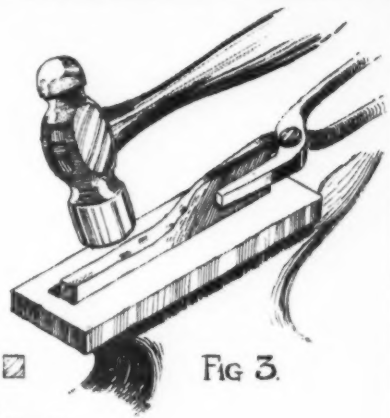


FIG 3.

G. DOUGLAS.

HOME AIDS

CORN EXCHANGE BANK
TRUST COMPANY
APRIL 1943
SUN. MON. TUE. WED. THU. FRI. SAT.
1 2 3
4 5 6 7 8 9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30
CORN EXCHANGE BANK TRUST COMPANY NEW YORK

Clothespin Holds Keys

THE lady who finds that she must dig around in the depths of her handbag whenever she needs that elusive key ring will save a great deal of time and energy if she tries this little stunt. A miniature or doll's clothespin will clip the key ring to the inside pocket of the purse and will keep it instantly available at all times.

Handy Calendar Marker

THIS simple marker for your calendar will show the date at a glance. It is made with a rubber band and a square of colored or black paper. Fold the paper in half over the band, pasting the halves together. Cut in it a window to fit the date on your calendar. Slip over the leaves as shown and move to required position.

Muffin Pan Serves As Emergency Tray

MANY times a member of the family is taken unexpectedly ill and is confined to bed. In such a case the matter of serving food to the patient becomes a problem. In the absence of a regular bed tray, an ordinary muffin pan will be found an efficient substitute. Foods set in custard cups and even glasses can be held securely in the muffin cups and will not slip as they would on an ordinary tray. The pan is easier to hold than a tray, also.

To Spread Icing

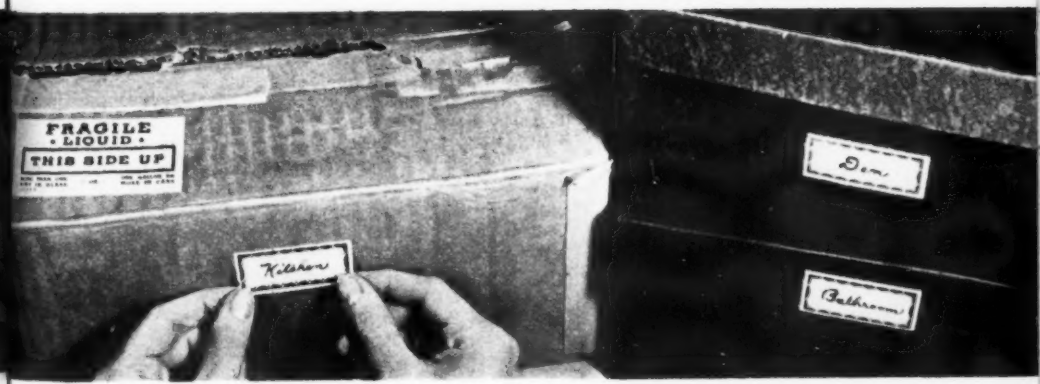
HERE'S a wrinkle housewives can use when frosting cake. Place the cake on the revolving stand of the electric mixer and turn it slowly while spreading the icing. Your job will be done in a jiffy, and the icing will be spread to suit the most exacting taste.

Dish Mop Cleans Springs

ONE of the most difficult items in the household to clean properly are the bed springs. Even the electric vacuum cleaner with all its attachments can't do a perfect job. An old dish mop, however, is just the tool. With its long handle it can be twisted in and out of the springs and will clean them thoroughly.

Labels For Boxes

THE next time you contemplate moving, this little tip will help you locate necessary items quickly in your new home and will facilitate unpacking and arrangement. Simply label each box as it is packed, placing on the label the name of the room in which the box should be placed in the new home: bathroom, kitchen, living room, den, etc.



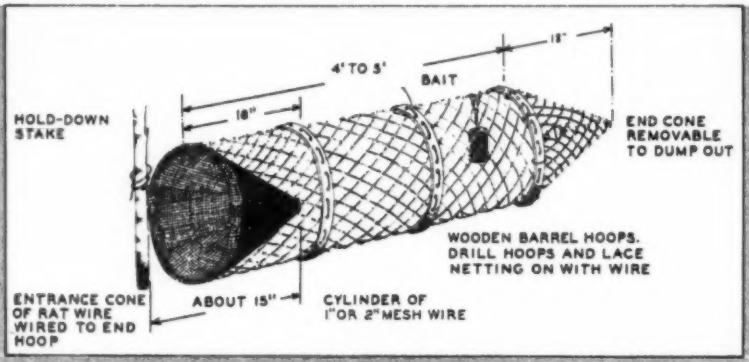
MR. TURTLE IS

IN THESE days of food scarcity don't overlook the common turtle as a source of meat to augment your rationed allowance. The flesh of the common snapper and several other types is tender, delicious and delicately flavored, perhaps because of their diet of fresh fish, frog's legs and herbage. Turtle is served by the best hotels and sold as a delicacy at fine markets specializing in unusual foods, but they're free to anyone for the catching.

You'll find edible turtles lurking in most small lakes, ponds, rivers, marshes and streams, probably close to home or near where you spend your week ends or vacation; catching them and preparing them for cooking are not difficult if the directions given here are followed.

The common snapping turtle ranges from the Atlantic to the Rockies and from Southern Canada to South Amer-

Left: A snapping turtle at close quarters is not exactly a thing of beauty, but his meat is tasty.


4' TO 5'
BAIT
18"
18"
HOLD-DOWN STAKE
END CONE REMOVABLE TO DUMP OUT
WOODEN BARREL HOOPS. DRILL HOOPS AND LACE NETTING ON WITH WIRE
ENTRANCE CONE OF RAT WIRE WIRED TO END HOOP
ABOUT 15"
CYLINDER OF 1" OR 2" MESH WIRE

Above: This cylindrical trap is a good turtle taker. Hold down stake should be long enough to mark location, set in 3 or 4 feet of water. Below, left: "Skinning" and cleaning are best accomplished with the turtle on its back. Right: Two small turtles or one of medium size will yield enough meat for six generous portions.

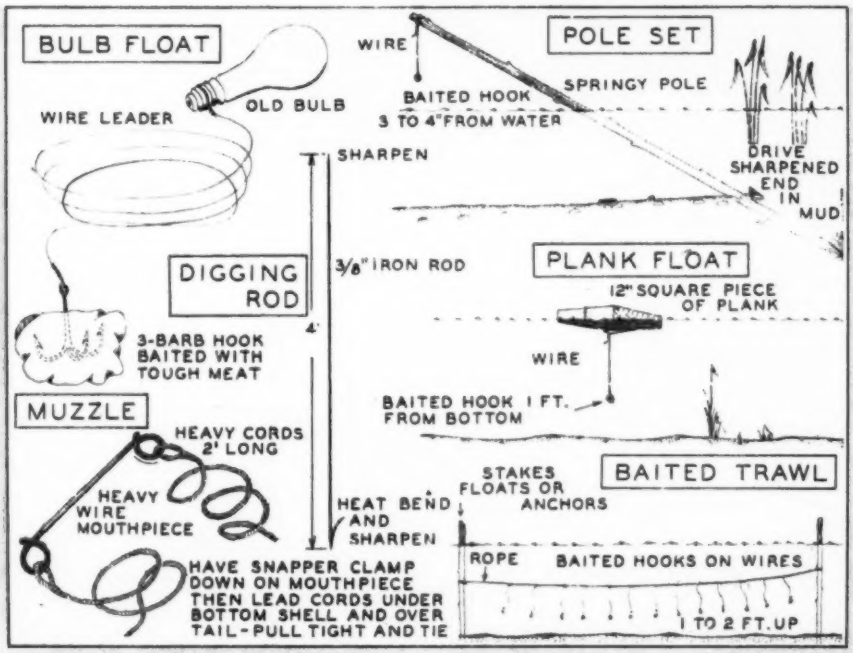
ISN'T RATIONEDI

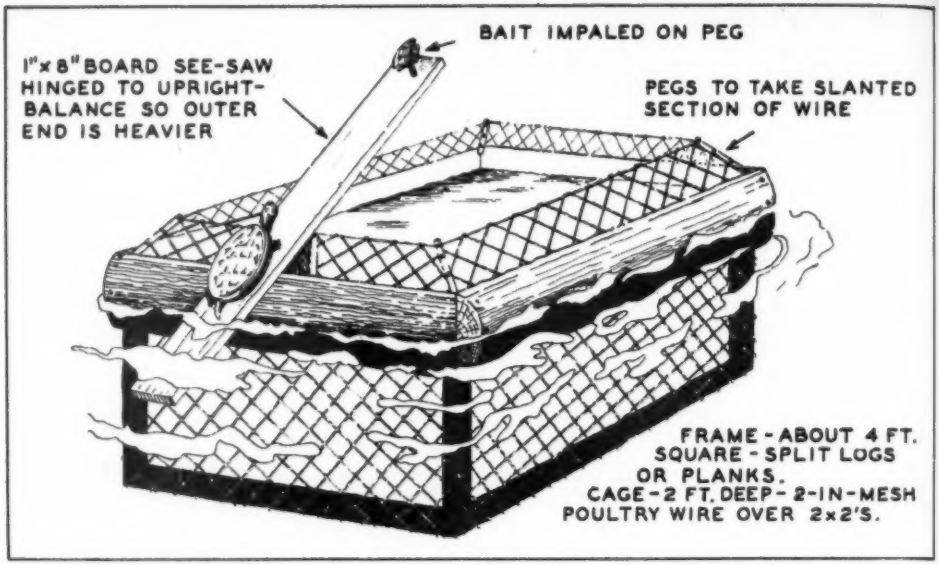
by J. A. Emmett

ica. An adult will weigh thirty pounds or more and measure two feet and up from tip to tip, but the smaller snappers you're more apt to catch are the finer flavored. The leather-back or soft-shell turtle has a flexible but tough shell, a small head with a sharp nose, and is considered by some even better eating than the snapper. Other edible turtles are the yellow-bellied turtle of the Southeast, measuring about ten inches across, and the scarcer diamond-back terrapin of the southern Atlantic states, running around eight inches in size. The common pond or painted turtle, easily recognized by its dark upper shell and yellow lower one is not considered edible.

In most sections turtles come out of hibernation in April or May and continue active until the first frosts of fall.

Turtles should be handled cautiously, held by a back leg and under sides to avoid a blitz on the fingers. This one is a small terrapin. Below: Various rigs for capturing the turtles.




BAIT IMPALED ON PEG
1"x 8" BOARD SEE-SAW HINGED TO UPRIGHT-BALANCE SO OUTER END IS HEAVIER
PEGS TO TAKE SLANTED SECTION OF WIRE
FRAME - ABOUT 4 FT. SQUARE - SPLIT LOGS OR PLANKS.
CAGE - 2 FT. DEEP - 2-IN-MESH POULTRY WIRE OVER 2x2'S.

This cage-type trap will catch a lot of dumb turtles. The poor dopes just walk the plank, lured on by the vision of something for nothing at the upper end. Their reactions seem almost human.

In early June the females wander considerable distances from the water to lay their eggs, and as their movements on land are awkward and their progress often slow they can be watched for and caught then. Aside from this you can catch them on a baited hook, dig them out of hibernation in cold weather, or use one of the traps shown here from May to October.

Catching on a baited hook is practical in most sections, although some states bar this method for market trappers, claiming the hooked turtle develops a fever that is injurious to the flesh. You can check up on this point in your state and act accordingly. Otherwise use a strong, three-barbed gang hook and a piano-wire leader with any gristle-filled meat or heads of fish and chickens as bait, concealing all but the shank of the hook. Turtles will seldom come near a tended line; it must be attached to some sort of float or to a spring pole and left overnight. You can use a wooden block float—a twelve-inch square of two-inch plank—attaching the wire leader to it to place the baited hook a foot or so from the bottom—or you can attach longer leaders to burned-out electric light bulbs and set a number of these in deeper water. Any turtle can easily pull the bulb under water but is not apt to keep it there. The best way is to set a number of rigs late in the afternoon, leaving them overnight to lift next morning for removing turtles and renewing bait. Another way, where the water is comparatively shallow, is to fasten the wire to a springy pole, two inches thick at the butt and eight or ten feet long. Sharpen the butt and drive it securely into the bottom at such an angle as to have the baited hook hang from three to five inches out of the water. The spring of the pole will tire out a hooked turtle yet keep him in good condition between times of tending the set. Trawl lines give good sport too; a length of stout rope or clothesline with wires and baited hooks a couple of feet apart along its length is stretched between two stakes or anchored wooden floats and tended each morning from a boat.

Traps are far more successful in the long run than baited hooks, but it takes a day or so for the turtles to become used to a trap's presence. Several common, easily made types are shown. Do not make a trap of new, bright lumber as the turtles will be very suspicious of it. Use the same baits as mentioned for fishing (chicken heads and fish heads are very effective) and staple or nail it securely to the bait float or to the shelf, as shown. Do not look for results the first night; give the turtles a couple of days to get accustomed to the trap being there. After that you can expect to get all the turtles in a small stream—as nightly catches grow smaller the trap should be

moved to a fresh location. Larger waters, of course, will permit leaving a trap in the same spot for several weeks, bait being changed or freshened up daily.

As in all trapping, a knowledge of where to make your sets is important. Turtles avoid waters that are too clear or too swift and are seldom found in lakes or streams with hard rocky bottom, or in mountainous areas. They prefer river holes where the current is slow; sluggish streams and marshy lakes and ponds; bayous, backwaters and oxbows where there is little or no current. On lakes look for fairly deep holes over a muddy bottom. They take bait in any form best at night and in rainy or cloudy weather.

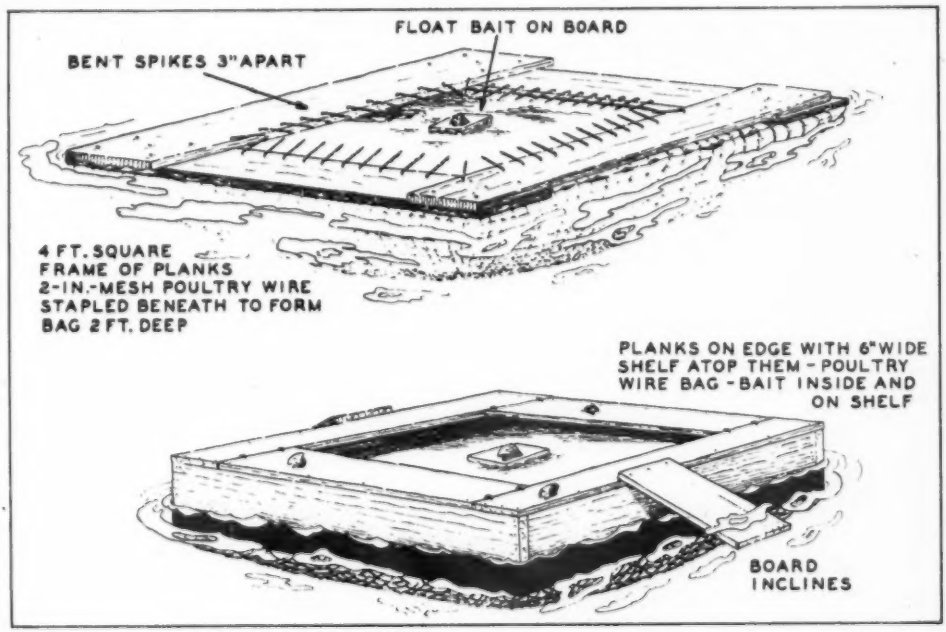
In addition to trapping turtles during the warm months you can hunt turtles in hibernation from October on. Look for them then in the headwaters of little streams, up muskrat leads, in patches of soft muck beneath overhanging banks, in boggy spots filled with stumps and wherever swamps have springs or water seepage. The turtle digs himself in six or eight inches deep until he's just about the water level with his head high enough to breathe. He likes the muck soft enough to permit his working deeper as the cold increases. He can often be located by a soft spot in an otherwise frozen area, where the heat of his body keeps the mud from freezing. The tool required for digging is a four-foot slim steel rod, one end pointed, the other shaped into a hook. The sharp end is used to prod likely looking spots and if you strike a turtle its shell will give off a sharp hollow sound. The rod is then reversed and the hooked end used to work under the shell and pull the turtle out. Often whole colonies can be pulled out this way; they should be placed in sacks to prevent freezing and stored in a tank or cool basement, where they'll keep a long time.

In many sections turtles can be bought very cheaply from fishermen who find them in their nets and traps yet do not catch enough of them to make regular marketing profitable.

A hooked or trapped snapper, or even one delivered you in a bag by a fisherman, must be handled with every respect, for those wicked jaws can give you a nasty nip. The tail is the safest handhold, one hind leg the next best, with the under side of the shell kept nearest you, as Mr. Turtle can reach straight up and out from his shell an incredibly long distance, but not far downward.

While there is absolutely no danger if you're careful, it should be mentioned that trappers claim a turtle will loosen its hold immediately if it is submerged [*Continued on page* 138]

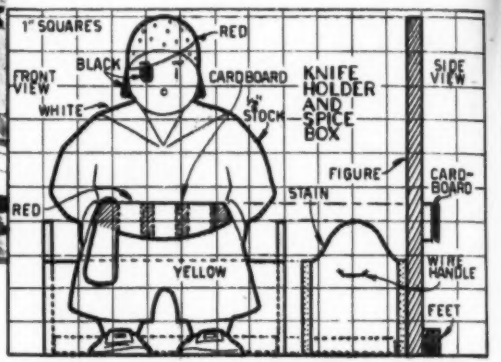
The traps below are easy to make from old boards and poultry wire. Bait which must be renewed daily, floats on a "raft" in the center of the trap.



WOOD-SCRAP CRAFT

Turn those leftover scraps of wood into clever little gadgets to brighten up your kitchen. Here are four which are very easy to construct.

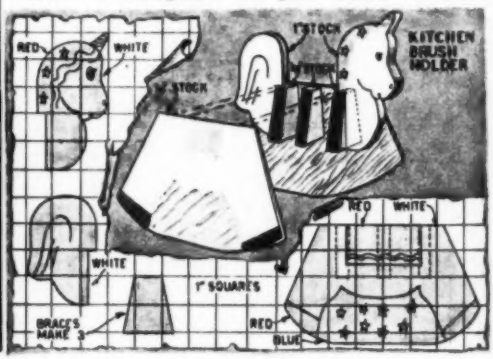
by R. L. Fairall



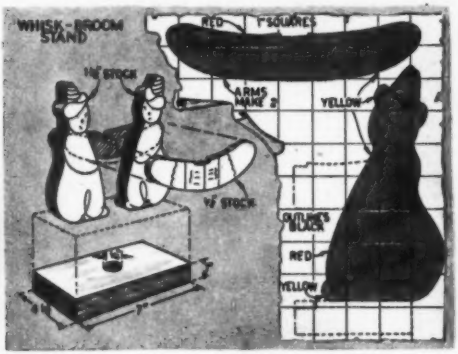
This pirate holds three paring knives in his belt.

THE first item is a small wooden pirate with three paring knives in his belt and a chest full of spices at his back. Jigsaw the pirate and his shoes from ½" stock and glue on the shoes; then cut the sash (the holder for the knives). Trace and cut one from ¼" stock and one from ⅛" stock, sandwich bits of cardboard between these two (the ⅛" section being the outside), and nail the sash to the figure. Cut the bottom of the chest from ½" material 6½"x2½", the ends 2½"x4", and the sides 7"x2¾" from ¼" stock. Nail the chest together and to the back of the pirate. Cut slots in the back of the chest so the names of the spices can be read easily, and paint the novelty with enamel. Colors are suggested in the squared drawing.

Here's a hobbyhorse for your kitchen brushes.

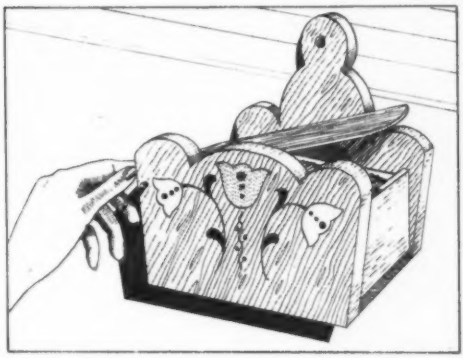


Two little men will keep your whisk broom handy.

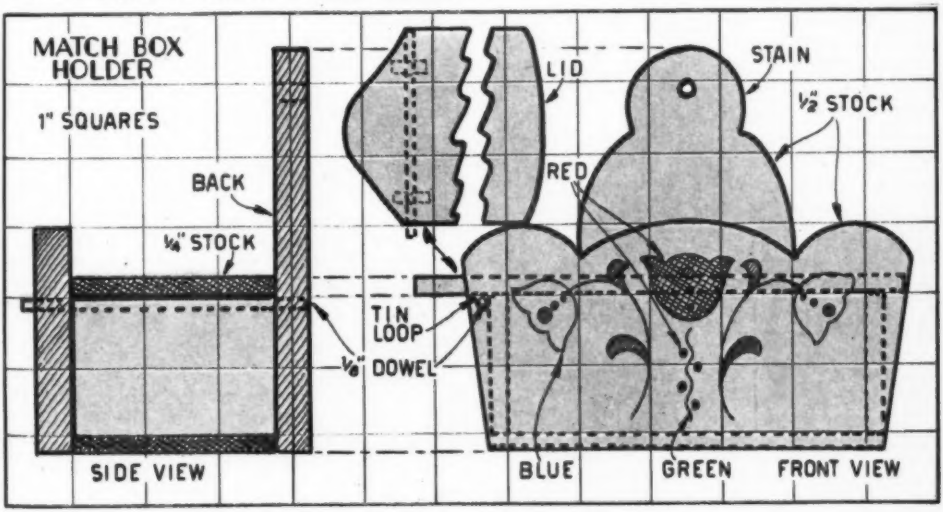


For those kitchen brushes which are always being misplaced, make a gay little hobby-horse holder. Cut the two side sections from ¼" stock and the three middle braces from ½" stock. Draw the head and tail on paper, trace to 1" material and jigsaw them out. Nail the head to a triangular brace and the tail to another; then set the middle brace in position and nail the sides to all three braces. Paint as indicated in the illustration, drop in the two brushes and your hobbyhorse is already to be helpful.

A decorative holder for a box of matches can be made from [*Continued on page* 146]



This is a decorative holder for a box of matches.



IDEAS FOR SERVICE MEN

Nail polish seems to have almost as many uses in the Army as ammunition, and we are practically convinced that the war effort would collapse without it. Here's another one, this time from a civilian lady whose nephew is a corporal. Mrs. John Schaeberle of York, Penna., says her nephew was visiting her on furlough recently, and while getting dressed to go out for the evening, lost the little metal tip from his shoelace. He hollered for the nail polish, dipped the end of his lace in it, and in a few minutes had the situation well in hand. Marines please take notice.

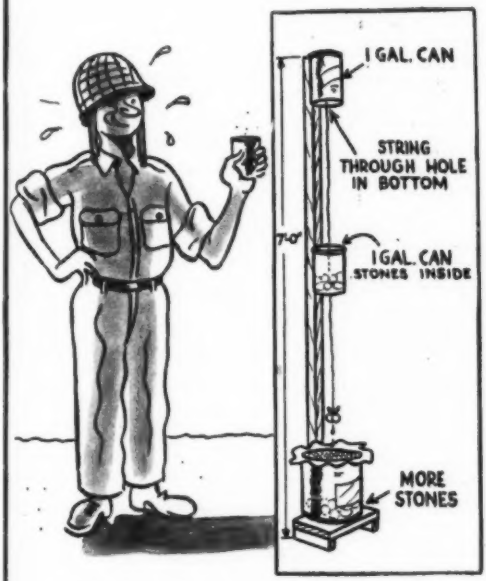
A corporal provides us with this second idea, also. He's Corp. Morris Cohen, Pittsburgh, Pa., who says, quote: Here's a suggestion for you boys that will turn out to be a priceless possession after the war is over. Have your folks purchase a large scrapbook with a nice, attractive military cover. Then, in each town that you visit purchase the view cards and send them home with instructions for the girl friend, wife or mother to paste them in the album. To these you may also add photographs, news items that deal with your outfit, your old stripes, insignia pins and the post newspapers. When the war ends you'll have a real record of your personal part in it.

Sgt. J. Donahue, Isolation Hospital, Kingston, Ont., Canada is the author of the next nifty, and with winter just around the corner you'd better take heed if you expect to be anywhere but in the tropics. Sgt. Donahue is with a motorized company, and its drivers make good use of a large pail filled with sand, NOT, as you may think at first, for air-raid protection. This sand is *hot*, and the drivers carry it on the floors of their unheated cabs, from which spot it radiates its warmth to keep them comfortable. Pretty clever these Canadians, eh wot?

Now we have a GADGET, thought up by Tech. Corp. Joseph W. Moreik, Jr., Camp Hyde, Ariz. The Corp. is with the engineers, and we can't think of a better branch of the service for his particular talents. Out where he's stationed it's hotter than the hinges of that awful place, and getting a drink of cool water represents a tough problem. Not too tough for this lad, however, who gets results as illustrated. Two one-gallon tins are fastened to an upright attached in turn to a sturdy base, the lower can containing stones. On the base, directly in line with the cans is a *two-gallon* tin, wrapped in cloth and also containing stones. A handkerchief acts as a strainer across its top. Stretched from top can to bottom, through holes, is a cord. Here's the pitch. Top can is filled with water, which runs down the string into second can, where stones help to cool it. Water then continues down string to bottom can, where it drips through filter. Believe it or not, by the time the water has made this trip you can hardly drink it without getting a chill. The whole affair is portable, and

can be carried on maneuvers. *Very* clever, and scientifically OK.

Our friend, Corp. Cohen is just bulging with ideas, and he hits us with another that leaves us hanging on the ropes. Everybody will like it except inspection officers and M.P.'s. Again we quote the Corporal, who seems to have a flair for expressing himself: "For you boys who sleep on the upper bay, here's a good suggestion to follow when the lights go out and you wish to continue that 'parlor golf.' Using the flashlight as a source of illumination, take two blankets (GI) and place them on the floor with a foot locker at the head of the game. The locker is also covered with a blanket. When the boys roll them cubes they



(the cubes) bounce off the covered foot locker and twist and twirl on the soft bed of blankets. This method will not interfere with the boys sleeping downstairs, and the muffled rolls plus the flashlight is guaranteed to pass the close scrutiny of 'change of quarters.'"

Ever have to live out of your old kit bag? Maybe it was a helluva mess, but Corp. R. A. McGregor of the R.C.A.F. in Sydney, N. S., fixed it up so it's almost as comfortable as home. (This seems to be a red-letter day for Corporals). Mac had a number of small bags made up, fitted with [*Continued on page* 140]

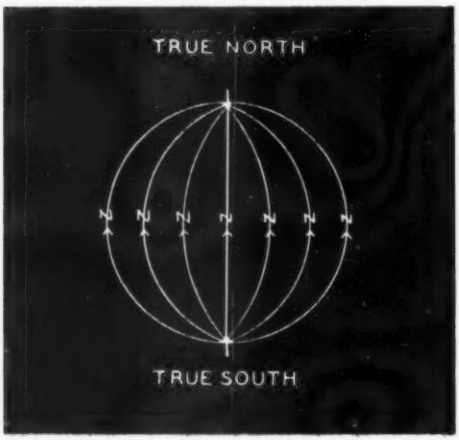
THE SCHOOL SHOP

Conducted by Gilbert Paust

Lieutenant, Civil Air Patrol, Westchester Squadron

Lesson 10—Dead Reckoning

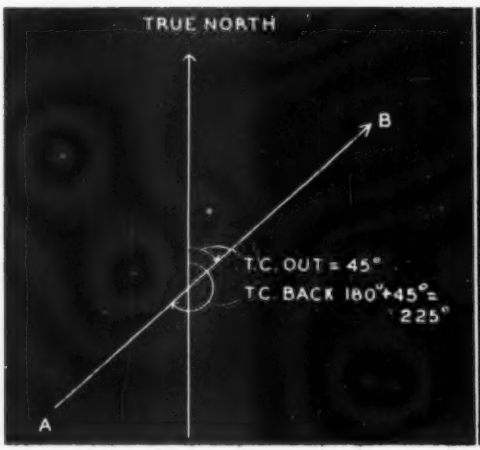
AT LAST we have come to the topic which is the really important part of navigation: *Dead Reckoning.* It is the determination of the compass reading necessary to fly from one place to another, and also the determination of the track and ground speed while flying. We might simplify the definition a little and call it simply "Flying by Compass."

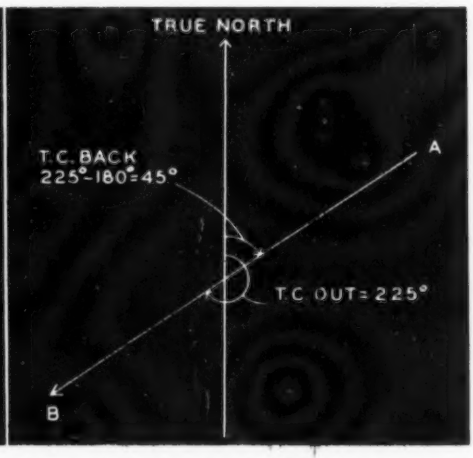


The meridians run through the geographic poles of the earth. Use them to determine the True Course.

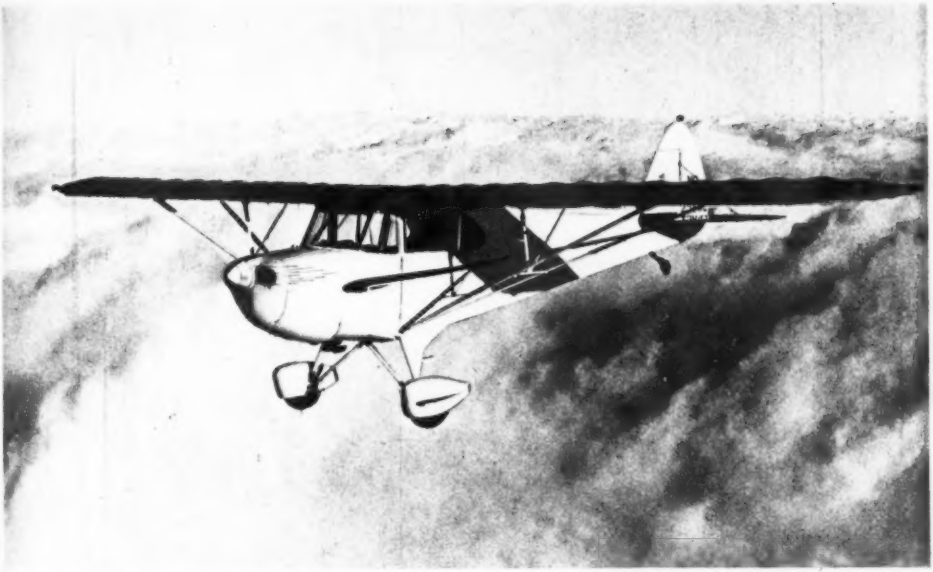
For some undetermined reason, Dead Reckoning has been responsible for more students being washed-out of ground school courses than all other subjects combined. It might be because this topic involves the use of a little mathematics. How much do you need? Well, when I say "little" I mean "little!" You don't need calculus, trigonometry, projective geometry or college algebra. Can you add 2 and 2 and get 4? Then you'll do, because simple arithmetic is entirely adequate. A former student of mine never went further than elementary algebra in high school, and he confessed to me that he passed that subject only by the skin of his teeth. In the Air Corps he graduated *first* in his class and is now a flight instructor on twin-engine aircraft, a job given only to the best pilots. So lay aside your math textbooks and we'll do some addition and subtraction.

In lesson No. 9 in Oct. MI we learned about *Piloting,* or flying from landmark to landmark. It is by far the simplest form of naviga-





True Course is the angle between True North and our trip, found by measuring in degrees on flight map.



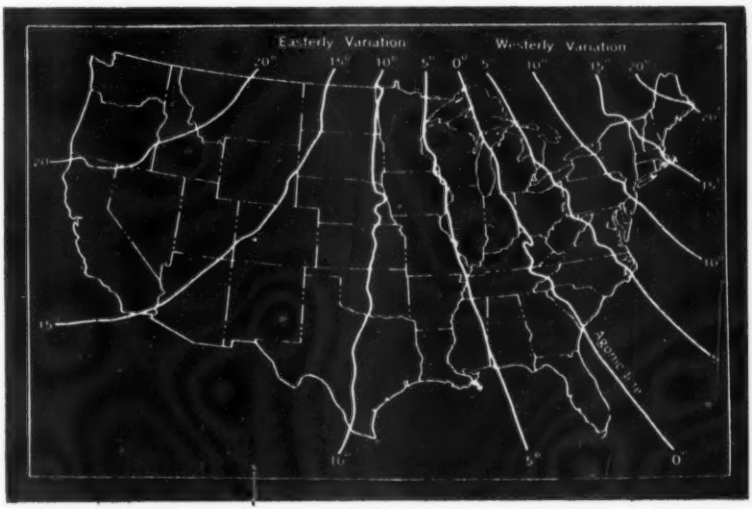
Dead reckoning is one of the most important parts of "blind flying" when landmarks are not visible.

tion, but on the other hand, it has the difficulty that on a long trip a pilot may become quite bored with searching the ground below him continually for landmarks. A much easier method is to fly by compass and use landmarks at scattered points along the course only as check points to make sure the plane is staying on course. To fly by compass is simple enough, but the problem of Dead Reckoning is to determine *what* compass reading to follow. Let's consider this practical example:

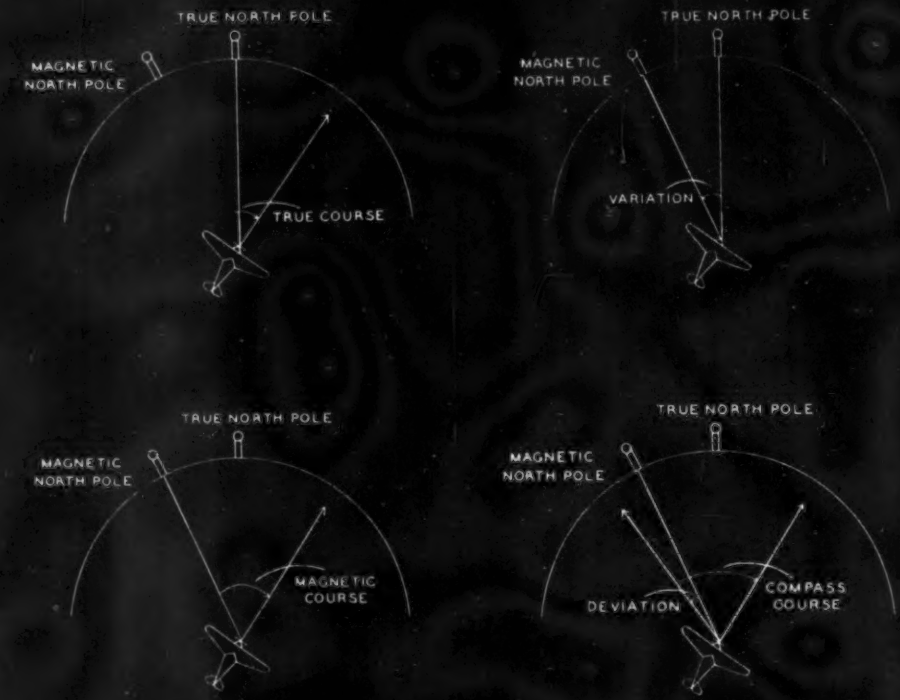
For	N	330	300	W	240	210
Steer	3	334	298	270	241	209
For	S	150	120	E	60	30
Steer	179	147	122	90	61	31

Shown above is a typical Compass Deviation Card.

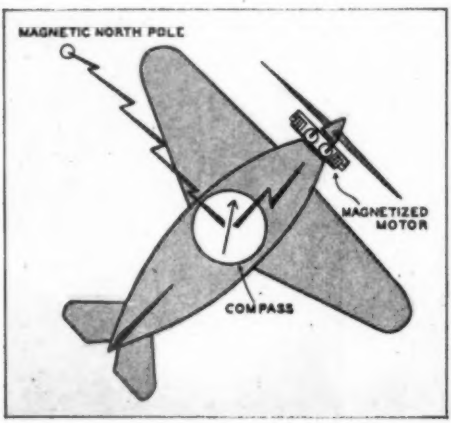
A pilot desires to fly from A-town to



Variation is shown by means of isogonic lines which connect points having the same value. These lines are irregular because of local disturbances. Agonic line is zero line.



Diagrams above show solution of a dead reckoning problem. First shows True Course measured from True North; second shows Variation (West in this case); and the third shows Magnetic Course, measured from Magnetic North. Deviation (West) and Compass Course are shown in the fourth. Deviation is caused by influence of magnetic fields in the plane (below).

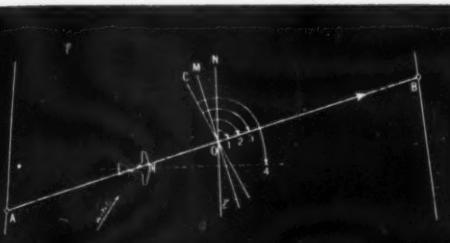


B-town. First he obtains a copy of the Regional Chart which will include his trip. (A Sectional Chart will do if his trip isn't too long.) Then with a pencil and ruler he draws a straight line between his point of departure (A-town) and his destination (B-town). To determine his course, he measures the angle between this line and the meridian *nearest the halfway point* of his trip by means of a protractor, which is obtainable in any dime store. This course is measured *from* the meridian *clockwise* from 0 to 360 as mentioned in a previous lesson. Since all meridians pass through the Geographic North Pole or *True North* Pole of the earth, this course just determined is called the *True Course* because it is measured with reference to *True North*.

In the first diagram at the bottom of page 118, the True Course *out* (from A to B) is 45°. The True Course *back* (from B to A) is called the *Reciprocal True Course* and always differs from the True Course by 180°. In this case it is 45° plus 180° or 225°. Here are some more examples:

If the True Course [*Continued on page 142*]

In problem below, 1 is True Course, 2 Magnetic Course, 3 Compass Course and 4 Compass Heading.



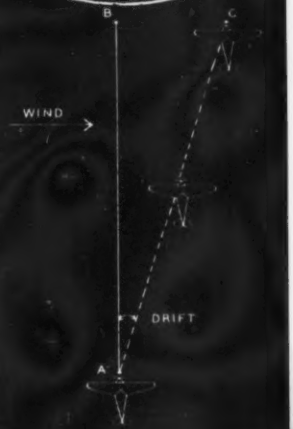
As shown at upper right, heading the plane to right of course increases course angle; heading it to left decreases course angle. Add a Right W.C.A. and subtract a Left W.C.A.

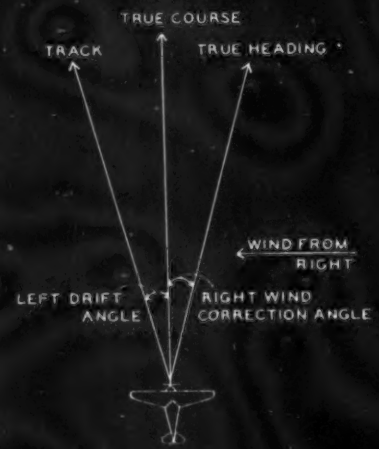
This fellow below knew it all and didn't study. Then the exams came!

The Drift Angle is illustrated at right. Correction for drift is made by heading plane into wind the proper amount.

Diagrams below show Drift and Wind Correction Angles with wind from the Right and the Left.

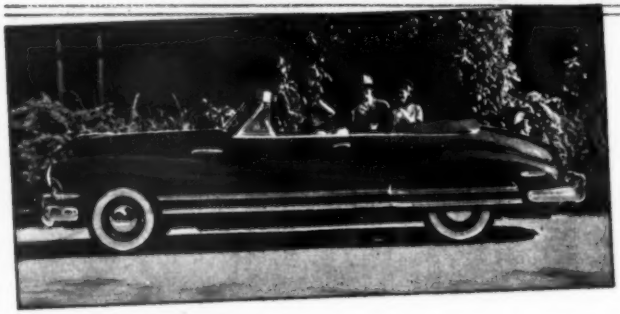
Cartoon by Dick Kraus





MODELS

BUICK "ROADMASTER"



Here is the final article in this series of models of interesting automobiles. It's the big, beautiful 1942 Buick, one of the last to be produced before the war stopped car making.

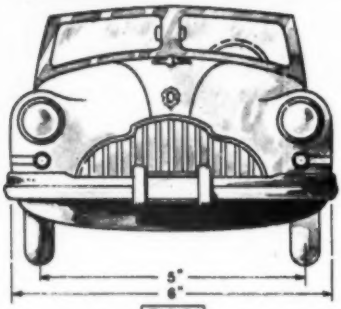


FIG. 3.
FRONT VIEW

THIS handsome 1942 Buick, one of the latest models produced up to the time war demands stopped production, deserves the most careful workmanship. With its marvelous streamlining it is essentially a wood carving project, and a very sleek model can result.

In Fig. 1 are shown the pleasing, long, low lines, with the front fender carried from the headlight clear back to the rear fender. A roomy cockpit with wide seats is made possible by absence of running boards, (Fig. 2). The low, wide effect is illustrated in the front view, Fig. 3, and in this as well as in the rear view, Fig. 4, the full, rounded contours are apparent.

Begin with a built-up, soft pine block (Fig. 5) in which

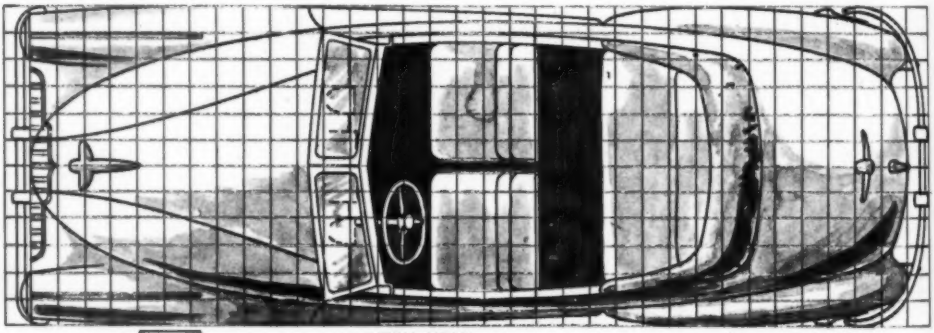
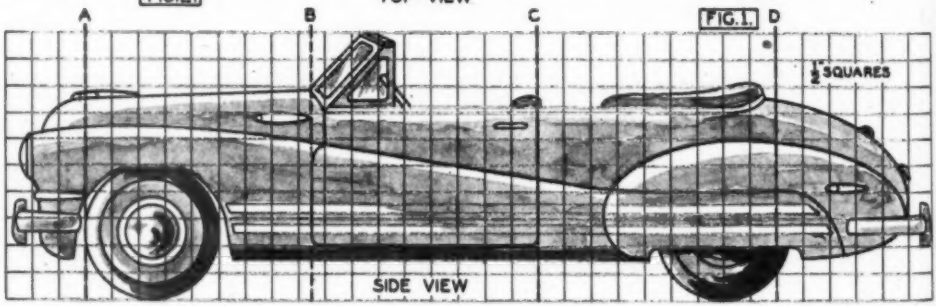
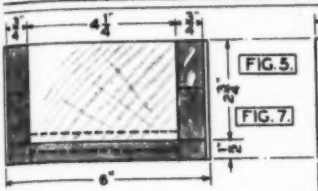


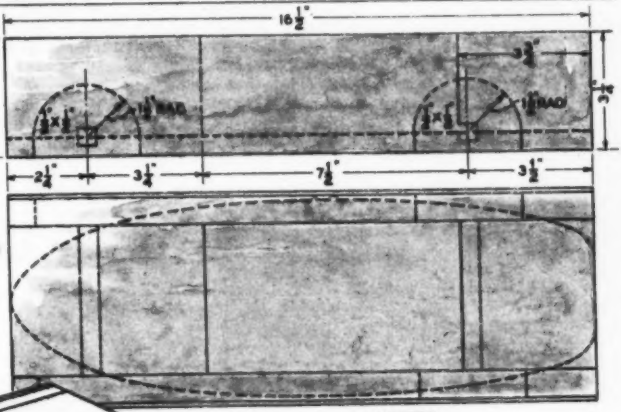
FIG. 2. TOP VIEW

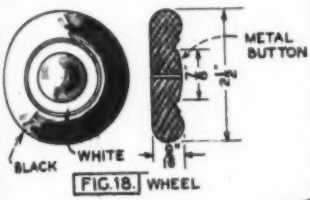


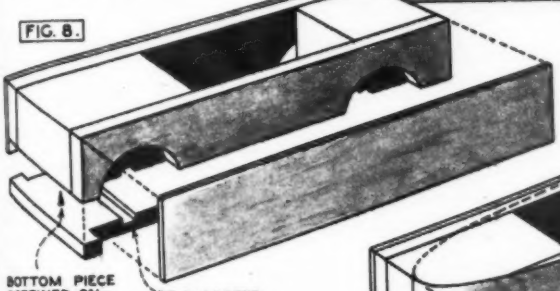
CONVERTIBLE COUPE

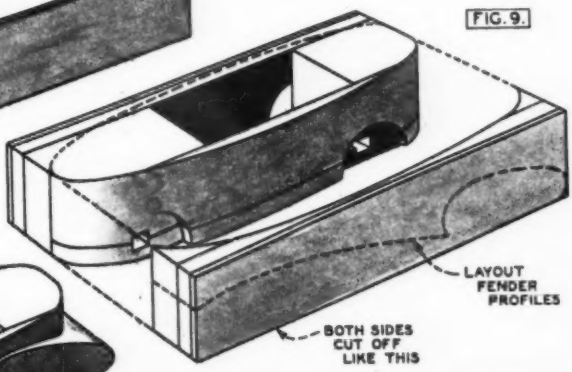
by Hi Sibley

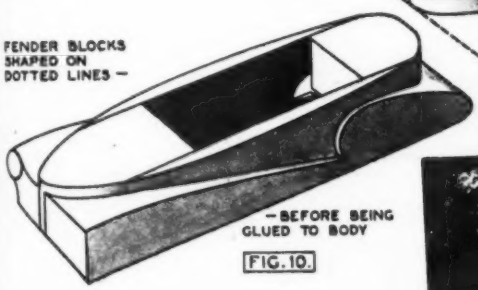












Right: Front details of this smart car.

the half-inch bottom member is secured with screws so that it may be removed for installing the axles. The built-up block consists of a piece for the hood and another for the rear deck, separated by the cockpit; on each side is a ¾" piece. After the wheel openings are cut in this, it is covered with a ⅛" piece on

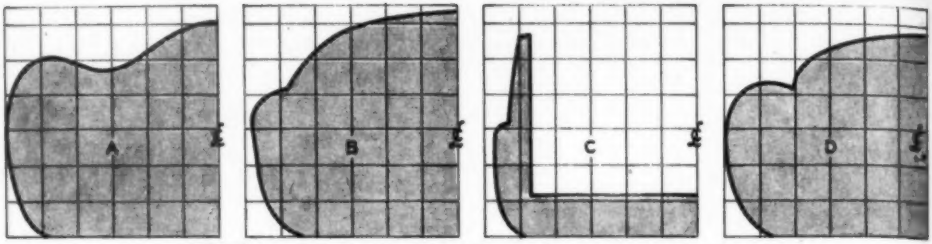


FIG.13. - TEMPLATES FOR CHECKING BODY CONTOURS AT STATIONS IN FIG.1.

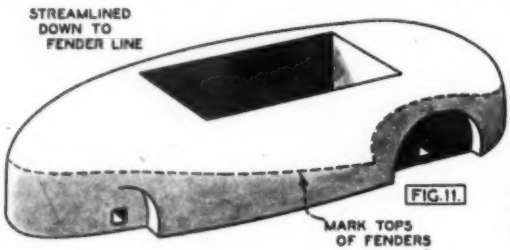


FIG.11.

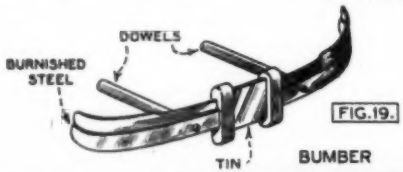
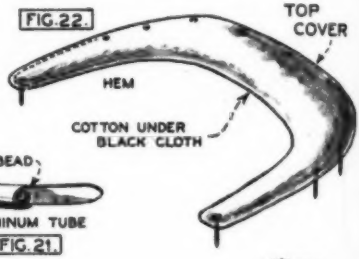


FIG.19. BUMBER

FIG.22.



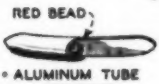
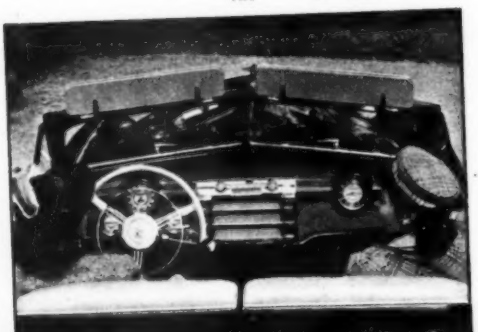


FIG.21.

DOOR HANDLE

FIG.20.

REAR DECK HANDLE



the outside, the whole business then glued together as in Fig. 6. An end view of the unit is shown in Fig. 7. Note how the side members are recessed for the wheels and the removable bottom rabbeted for the wooden axles, Fig. 8. Next cut the outline of the body as indicated in Fig. 2 and again in Fig. 6. With this step, the model will appear as in Fig. 9, and the fender outlines should be marked on the side pieces that have been cut away. Get the layout from Fig. 1. Scroll-saw the fenders as in Fig. 10, and roughly streamline them before gluing to the body.

Mark the outline of the fender tops on the body, and round and smooth the latter in its approximate final shape, but do not work on the wood below the fender lines, Fig. 11. Scroll-saw the seats and fit them neatly into the cockpit, temporarily. Note that they are cut from one

Above: Follow this dashboard arrangement when making your model. Left: Top up, the car is still a thing of beauty.

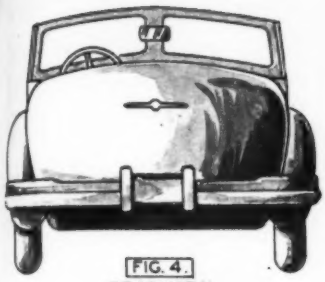
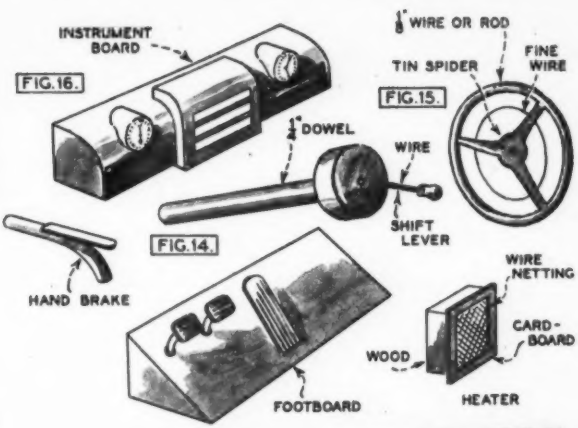
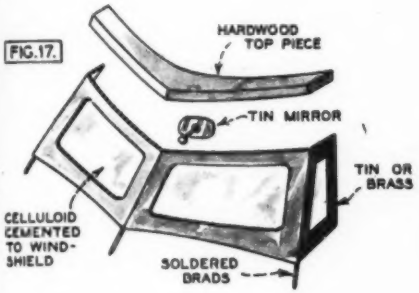


FIG. 4.
REAR VIEW





piece—two front seats and one rear, as in Fig. 12.

You may now go ahead with the finished carving, using gouge, rasp, sharp jackknife and sandpaper, checking the work with templates, Fig. 13. A good plan is to cut these templates from stiff bristol board and at the stations A, B, C and D (Fig. 1) trim the wood down to fit the templates, after which the stock between can be faired off to the proper [*Continued on page* 140]

Above and below are more views of the car, to check against your work for correct appearance. At right is a Buick experimental model based on the "Roadmaster." Post-war cars may look like it.

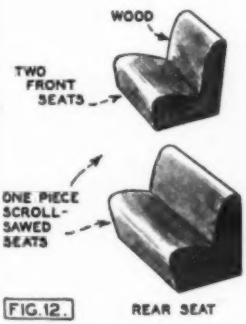
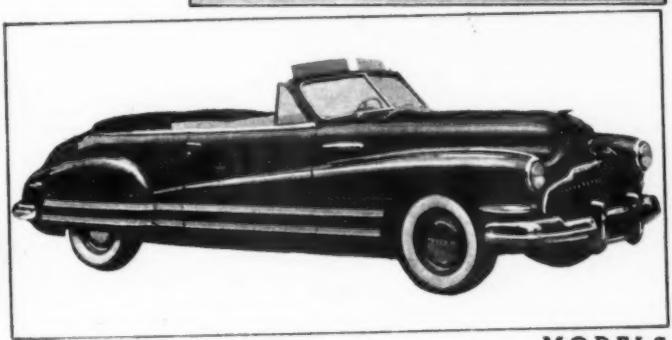
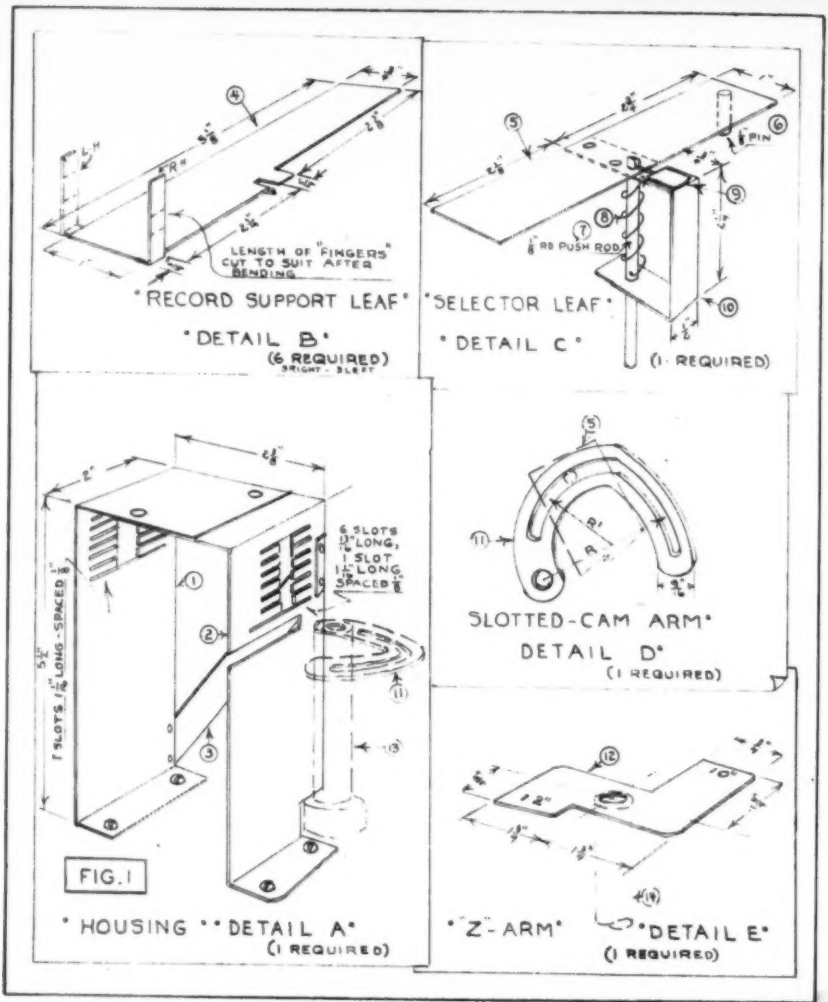


FIG. 12. REAR SEAT





MAGAZINE FOR THE MI RECORD CHANGER

by A. H. Smith

This magazine will make a handy addition to the automatic record changer described in the November, 1942, Mechanix Illustrated and in Radio Manual No. 3. It handles warped and off-gauge records efficiently. Construction is easy.

IN a home-made record changer considerable difficulty often may be experienced in the operation of the selector plates which feed the records. This is due partly to variable thickness of records of different manufacturers, but more often is caused by warped records. There should be a law against filing records in a vertical position, but as long as cabinets are so constructed, we shall be cursed with the warped-record evil. It is practically impossible to space rigid selector plates to "slice" off the bottom record when the space between stacked records may vary from $\frac{1}{16}$" to $\frac{1}{8}$" or more.

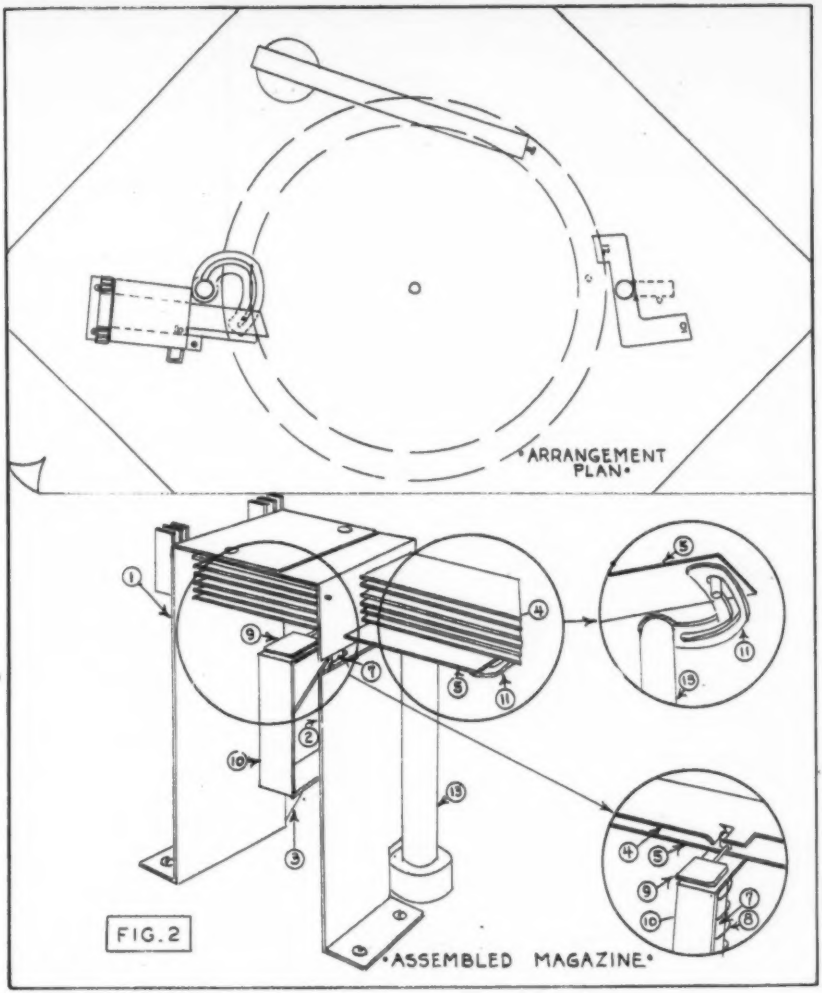


FIG. 2

Precision construction in the home workshop is usually not possible, and coupled with the non-uniformity of records, a device suggests itself whereby records may be loaded into a magazine and fed one by one with certainty and automatically.

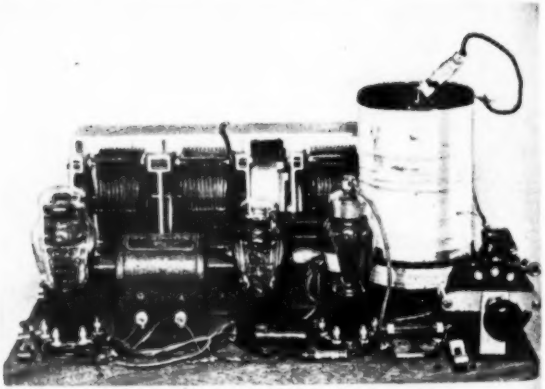
The usual album does not exceed six records. Therefore in designing a magazine let us consider six as a satisfactory number which need be loaded at one time. In the case of twelve-inch records, this will provide a minimum of thirty minutes of continuous music.

The record magazine described and illustrated here has been designed with the limitations of the average home-workshop in mind. All parts can be cut out on a power jig saw, or, with somewhat more patience, with a hand jig saw.

Construction and operation are simple. Practically any sheet metal may be used provided only that it is of sufficiently heavy gauge to be rigid when completed. The writer built the magazine of some old sample color plates (useless in the scrap drive) which were of approximately 18-gauge furniture steel, approximately 3/64".

The *housing* (Detail A, Fig. 1) is made in two sections. In the left end (part 1) guide slots are cut spaced ⅛" apart, $1\frac{1}{16}$" long and wide enough to provide a free bearing for the record-support leaves (part 4, Detail B). The right end (part 2) is treated the same except the slots are [*Continued on page* 148]

LONG-WAVE RECEPTION WITH OLD BC RECEIVER



This set was converted to long-wave,

by L. B. Robbins

NOW that amateur short-wave transmission and reception are curtailed, one can gain a lot of pleasure and education from listening on the longer waves above the broadcast band. There is plenty of slow code moving, and that makes an excellent way for the aspiring student of code to gain practice and efficiency. From an old BC receiver lying around unused, a long-wave receiver can be built up at practically no expense. Aside from the audio section, it is necessary only to increase the coil size and tuning condenser capacity to reach these longer waves or "low frequencies." With the exception of a three- or four-section ganged condenser and a coil of from 300 to 500 turns, the circuits are the same as usual for a straight regenerative set. The receiver illustrated was built up entirely of old parts and gives fine results.

First a base was made of wood large enough for all parts. A four-section ganged condenser was altered so all rotors were in series and all stators in series. In this case it gave a capacity of about 20,000 mmfd., 92 plates in all.

The sockets were changed so the detector, a 58, used a 6-prong socket. First audio was a 56 using a 5-prong [*Continued on page* 146]

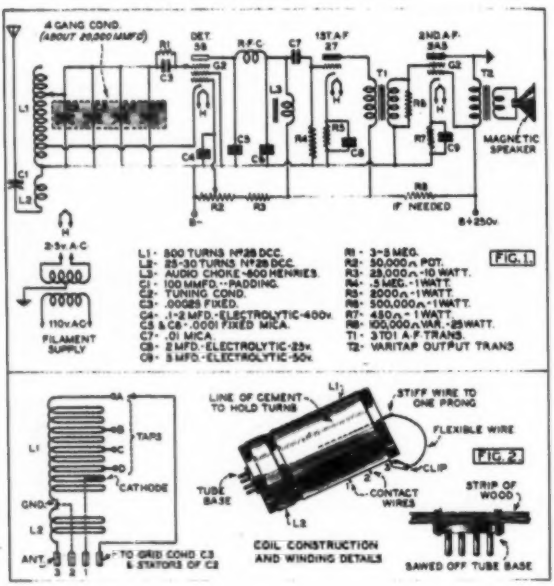
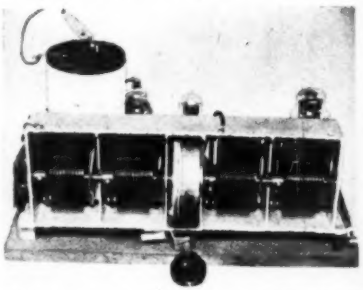
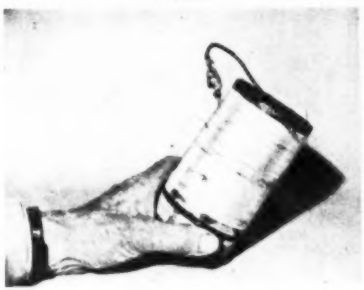
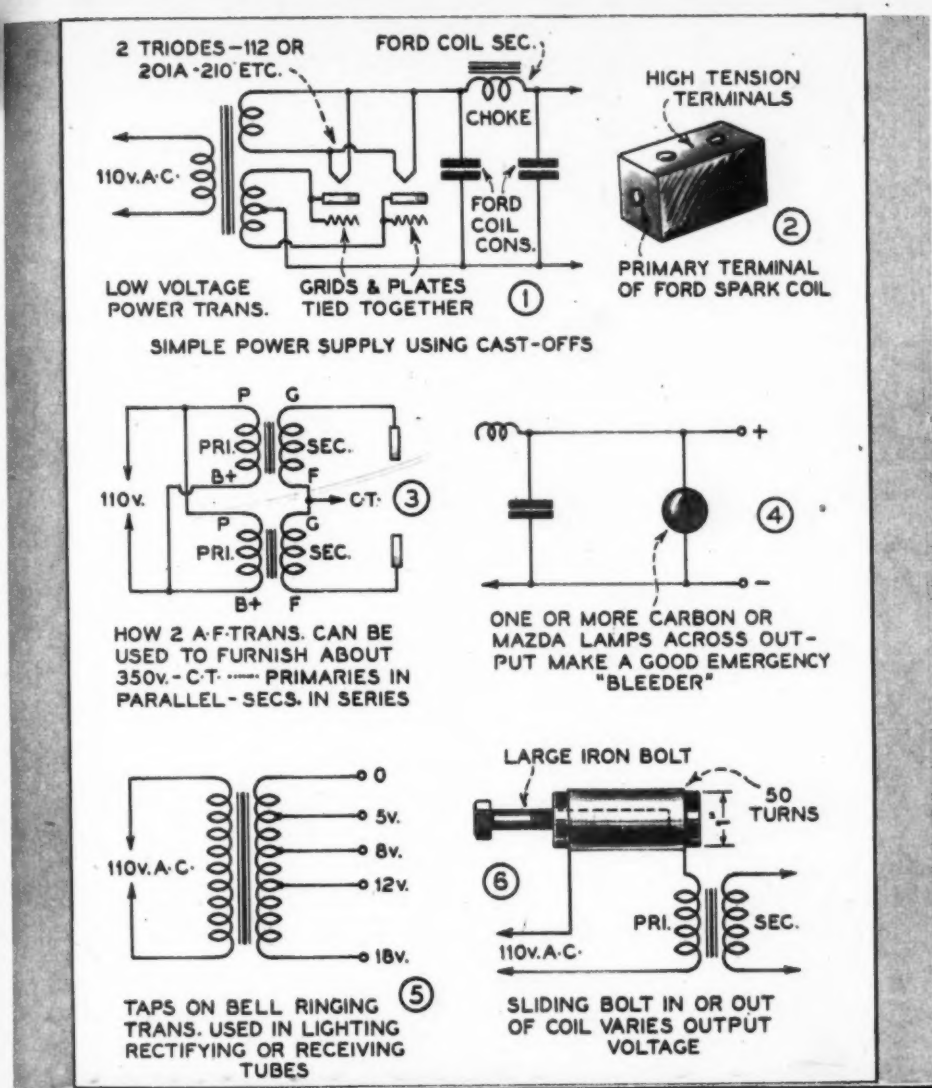


Photo below shows ganged tuning condensers. The coil is shown at the bottom.







EMERGENCY POWER PACKS

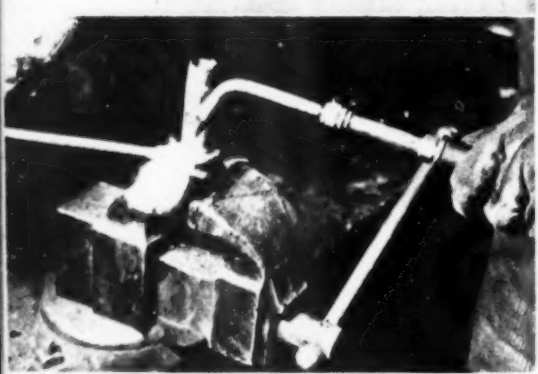
DURING these times the radio experimenter and constructor must utilize old parts and otherwise obsolete material in his lab, his duty in the war effort. The accompanying sketches illustrate how some of these pieces of so-called junk can be assembled to serve a good purpose in power supplies.

In Fig. 1 is shown a power supply that has real usefulness. Its full-wave characteristics are obtained by utilizing two old-type filament tubes such as the 201A, 112, 171, 210 or such type of triode. Wire the filaments of two sockets in parallel and tie the grid and plate terminals together as shown. The only regular item called for is a power transformer with suitable filament supply and center-tapped power winding. The filter choke can be the secondary of [*Continued on page* 146]

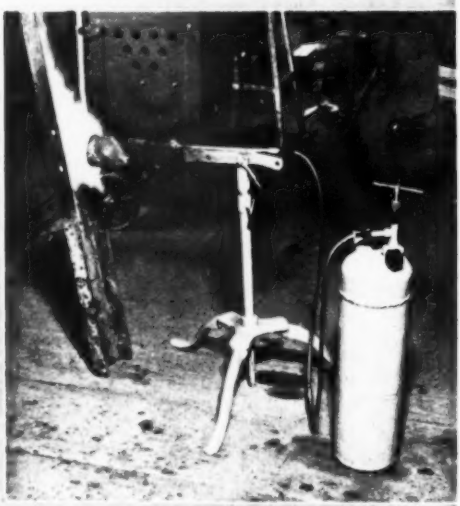
WELDER'S PREHEATING OUTFIT

Designed for a welder's use this efficient preheating outfit can be made from scrap pieces and uses gasoline.

Complete welder's preheating outfit. Gas is fuel.

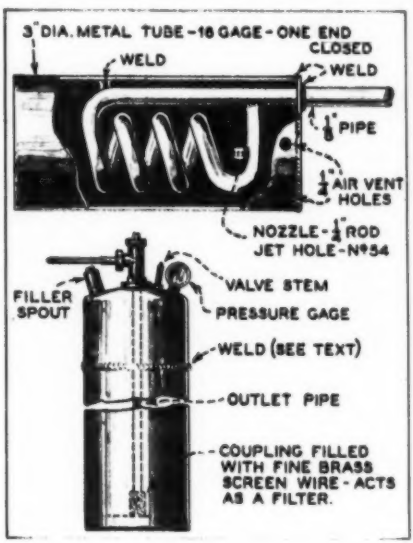


Here is simple method of bending pipe coil.



Above: Outfit in use. Right: Details of coil, jet tip, etc. No. 54 bit is used to drill jet tip hole.

THE Presto-Lite tank, obtainable from most junkyards, makes a strong safe tank capable of withstanding considerable pressure. First, it will be necessary to saw it in two and remove the packing material, after which the parts are welded back together again. The pressure gauge is removed from the bottom end and installed at the top end. The valve, an ordinary metal tire valve stem, is also installed in the top end. Drawings show how the outlet pipe which reaches almost to the bottom of the tank is installed. The filter for the opening of this outlet pipe is made by closely crumbling fine brass mesh screening and forcing it into the pipe fitting, as shown in drawings. The flexible hose from tank to preheating unit is a hydraulic brake cable. The coil in the [*Continued on page* 150]


3" DIA. METAL TUBE - 16 GAGE - ONE END CLOSED
WELD
WELD
⅛" PIPE
¼" AIR VENT HOLES
NOZZLE - ⅛" ROD JET HOLE - No 54
FILLER SPOUT
VALVE STEM
PRESSURE GAGE
WELD (SEE TEXT)
OUTLET PIPE
COUPLING FILLED WITH FINE BRASS SCREEN WIRE - ACTS AS A FILTER.

A Lift from the Front at Guadalcanal

FOR all its grimness, modern war is merciful to our wounded. The life-giving miracle of blood plasma* ... the swift, efficient treatment behind the lines ... plus speedy transport to finely-equipped base hospitals ... result in an incredibly high proportion of recoveries among even desperately stricken men.

Speedy Transport! It may be by giant transport plane, by ambulance or nimble-footed Jeep ... or at jungle fronts in the South Pacific, by outboard-driven small craft threading narrow rivers, saving priceless hours between front lines and the base.

Evinrudes are busy at innumerable tasks for the Army and Navy, Marine Corps and Coast Guard ... driving swift assault boats ... propelling pontons, lighters, ferries ... powering huge rubber rafts, wherries, small craft of every type. *After Victory* there will be peacetime Evinrudes worthy of the traditions of their fighting forebears!

EVINRUDE MOTORS, *Milwaukee, Wisconsin*
Evinrude Motors of Canada, Peterboro, Canada

EVINRUDE
OUTBOARD MOTORS

**A pint of your blood can save the life of a wounded soldier or sailor. The need is constant, pressing. Call your local Red Cross Chapter for an appointment.*

"Mariner Junior" Engine

[*Continued from page 97*]

The cylinder head is machined in the shaper (Photo 10), while held in the shaper vise. Very fine cuts are taken and a straight, smooth surface is obtained for a tight fit on the cylinder block. In Photo 11 the casting is reversed where the top is machined smooth while resting on parallel blocks. This operation can also be accomplished in the four-jaw chuck if a mill or shaper is not at hand. The work thus far completed is shown in Photo 12, while in Photo 13, the cylinder head is being drilled for fastening to the block. When clamped and accurately adjusted in place the screw holes are drilled with a No. 21 drill, which is tapping size for 10-32 threads. The holes in the cylinder block, which are $\frac{5}{16}$" deep, are tapped while those in the head are opened out to clear the screws with a No. 11 drill.

The crankcase bearing plates are machined in the three-jaw chuck Photo 14, the shaft hole being drilled and bored when the inside of the plate is turned to size, making the hole concentric with the outer diameters which fit into the crankcase openings. The bronze main-bearing bushings can be machined by drilling and reaming the shaft hole while held in the three-jaw chuck, then mounting on a mandrel held between centers where they can be turned to shape on the outside for a tight press fit in the bearing plates. With these in place the oil holes are drilled, as in Photo 15, through both the aluminum plates and bronze bushings, the hole being drilled through the heavy web of the bearing plate which is made slightly larger than the others for this purpose. The center bearing is cast in two halves so it can be mounted between the webs of the crankshaft, and the first job to do on this part is to machine the flat surface at the joint (Photo 16), when the two parts can be drilled, tapped and firmly screw-fastened together. The shaft hole can then be drilled and reamed, while held in the three-jaw chuck, and the work mounted on a mandrel held between centers where the outer surfaces can be turned to shape and the diameter to an accurate fit in the crankcase. Oil holes must also be drilled in this bearing, but the screw hole for holding it in place will best be left until the bearing is finally fitted in place, when the hole can be drilled through the crankcase into the bearing with no alignment troubles. The three completed main bearings are shown in Photo 17, ready for assembly, while in Photo 18 the bearing plate is in place and being drilled with a No. 50 drill for the 2-56 hexagon head screws which hold it in place. With the mounting of the crankcase bottom plates (Photo 19), the main cylinder casting is set aside and work started on other parts.

The cylinder liners, next on the list, are machined by chucking the three-jaw chuck as in Photo 20 where the bore is brought exactly to size and the walls to a mirror-like finish. This is done by applying soft soap in the bore for the last finishing cuts and grinding the cutter to a fine point which is then honed flat on the very tip. Light cuts are made and extremely fine power feeds used. The gibs on the cross slide and compound rest should be tightened if they are at all loose, and no play should remain anywhere to cause chatter. If inside mikes are not available, a plug gauge should be made up in advance to make sure both cylinders will be bored the same size. The outside of the liners is turned to size on a mandrel. If this is not available in the 1⅛" size, one can quickly be made up by chucking a suitable bar of steel and turning it to size while supported by the tailstock center. Turned in this manner it should run dead true. Do not remove it from the chuck until the work on both liners is completed. These are slipped over the mandrel and turned to the dimensions called for in the drawings as in Photo 21 where the outside of the liner is brought exactly concentric with the bore. The intake and exhaust ports are next layed out (Photo 22), and in doing this great care must be used. It will be found most convenient, in scribing the outlines, to hold the work in the four-jaw chuck. This will make it an easy matter, with the aid of the chuck jaws, to locate the ports properly and line them up accurately, a sharp pointed tool bit being drawn across the work with the lathe carriage for the horizontal lines while the chuck is slightly turned by hand for scribing the right angle lines. A look at the drawings will show the ports cut in pairs and both liners not alike, the exhaust ports each facing the port side of the motor while the intake ports face each other fore and aft. The center of each port is accurately located, center-punched and drilled as indicated in Photo 23, it being an easy matter then to bring the holes to shape with a small square file. The completed liners are shown in Photo 24 ready to be pressed into the cylinder block. This can be accomplished between the jaws of a husky vise. It will be well, however, to expand the holes in the cylinder block by heating the casting in boiling water, while the liners can be shrunk slightly in size by cooling for awhile in the family icebox. Everything should be in readiness and the work done quickly before the liners have time to take on the heat of the cylinder block. If the parts have been turned accurately for a good press fit, no trouble should be experienced and when the casting cools the liners will be permanently in place.

This concludes Part I of the article on the *Mariner Junior* engine. Part II will appear in next month's (December) issue of MECHANIX ILLUSTRATED. Be sure to watch for it!

Harley-Davidsons are Really *Standing Up!*

On all war fronts, the men who ride and service Harley-Davidsons are learning what "dependable performance" really means. You can't beat tough war action for proving that Harley-Davidsons can "take it and dish it out."

One fighter wrote from (CENSORED): "We're in an ordnance maintenance outfit and I'm overhauling trucks, cars and small engines. Harley-Davidsons are really standing up. They get twice the mileage and abuse other vehicles get before they need attention. I intend to get a new 74-OHV Harley-Davidson when I get back to the good old U. S. A."

Hundreds of these letters continue to pour in—and the story is always the same. Put your fighting dollars in War Bonds — and join the riders who are going to own newer, better Harley-Davidsons after the war!

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Lathe Tools From Old Files

[*Continued from page* 107]

the job on hand. I have found that to make a tool by simply breaking a piece from an old file and grinding it to shape isn't very satisfactory since it is apt to be very brittle and its cutting edge very weak. The best method is to soften the files first, then shape them and finally reharden and temper them. To do this heat the file bright red and allow to cool, preferably while buried in warm ashes. Next cut off a suitable length and file the cutting edge to shape with small flat and round files. To those home workers who are used to filing, this operation is much quicker and easier than grinding.

When you have the tool shaped up, heat it again to a bright red and quench it quickly in cold water. This will harden it. Polish the point and shank with fine emery cloth and you are ready for tempering. Grip the tool at the center with a pair of pliers and, holding the shank end in a gas flame or other convenient source of heat, watch carefully for the temper colors to appear. They will show up in straight lines across the shank, light yellow first, then darker yellow through brown to blue and purple. When the light yellow or straw color reaches the point, dip the tool quickly into cold water. This will give a hard, tough, cutting edge that will stand up to heavy cuts. As the steel in different makes of files varies, however, a little experimenting with the tempering may be necessary to get the best results. If by chance the tool is not satisfactory, heat bright red and harden as before, polish with the emery cloth and temper again allowing the darker yellow to reach the point before quenching.

The two boring tools D and E, Fig. 2, were made from flat files. The files were first heated and hammered out to a square section as shown in Fig. 3. The cutting ends were bent while hot and then filed to shape after cooling. The shanks were filed to a round section for about half their length from the cutting edge, the other end being left square to fit the tool post. They were hardened and tempered in the same manner as the straight tools.

Square files, of course, make the best tools, but since the flat and three-cornered types are generally the most used, the home worker is more likely to have a few old specimens of the latter on hand.

If these tools are made and tempered with a reasonable amount of care, they will stand a great deal of heavy work, and when they become dull, a touch on the emery wheel and a rub on an oil stone will quickly restore their keen edges.

During the first eleven centuries of her recorded history, Japan was engaged in only one war abroad.

A world population increase of 250 million people in the next 20 years is expected despite the present war.

Streamline Your Models

[*Continued from page* 85]

and exposure time, and kept on file to facilitate making duplicate streamlined prints of identical quality.

In most cases it will be found that only a very slight paper curve will do the trick. Too high a curve will often result in overcorrection and distortion and should be avoided.

This streamlining process can be applied also to other forms of subject matter besides human models. For instance if you want your car to look like a limousine instead of an ordinary sedan, just curve the middle of the bromide paper under the enlarger when printing the picture and you can lengthen your car to almost any degree, as can be seen in photos on page 85. The same stunt can be applied to a small house or similar object.

Animals, such as the dachshund at the beginning of the article, also make good streamlining subjects. Of course, in this process it is necessary to stop your enlarger lens down as far as possible to get a greater depth of focus, and subsequently a longer exposure will be needed.

Don't despair when your models complain that you make them look too beefy with your camera! With a little practice you will be able to improve many of your pictures. You can always chop off a few pounds and add a few inches to their height via the streamlining process.

File For Miniature Negatives

[*Continued from page* 87]

thicker and bulkier than their ends in the binding, the book will be difficult to bind together unless equal bulk is added to the binding to balance the pages. This can be done, simply, by cutting strips of cardboard into lengths measuring ½"x10⅝" and punching holes in each to correspond with those in the album pages. These strips of cardboard can be used as spacers by placing them between the pages when binding the album. This will bring the binding up to the thickness of the loaded pages and permit the book to lie flat.

Since the album pages are white, all negatives except those that have been considerably overexposed can be plainly seen without removing. To further simplify the search, a handy card file can be kept to index all negatives according to their subject classifications as shown in the photo. By numbering the pages of the album consecutively, the page on which each negative is kept can be marked on its respective card in the file.

Pages can be added to this album as needed, but 40 pages will be a good maximum. This will make a total of 1,120 negatives filed in a single book.

Pages from old telephone directories are placed over airplane engine molds to keep out dirt; when the molten metal is poured in the mold the paper is burned away without residue.

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YOU'RE LOOKING at a highly specialized instrument of great precision . . . designed to crack a continent.

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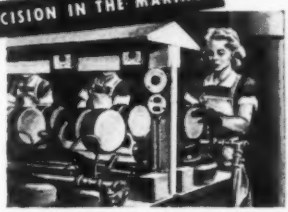

A craftsman with a hundred hands

Polishing with rouge is the final step in the grinding and polishing of lenses and prisms for Universal Binoculars. For this process, Universal-designed machines have converted what was formerly an extremely slow hand operation into a miracle of *quantity production,* while maintaining the highest precision standards.

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The Microscope: Shop Helper

[*Continued from page* 106]

and in an instant the observer will know a half-dozen important facts about it—the smoothness of the tool's cutting edge, the behavior of the metal during machining, effect of cutting lubricants, and so on. The examination of threads with a microscope at 10 to 25 diameters will reveal much about their smoothness, shape, and size. The photograph shows a milling-cutter arbor arranged on a simple stand made of scrap boards for inspection of the threaded end. In this case it was found that a slight non-uniformity existed in the threads, indicating that the lathe bit had not been set squarely with the work when they were chased.

A polished surface is a collection of lines too small to be ordinarily visible, but to the microscope they are as big as plow furrows; and a glance through the eyepiece will tell more about a certain polishing job in a second than can be found by other means in a day. With the help of even a very cheap microscope, the best grinding or buffing abrasive can be selected from a group. Usually the polished surface is examined rather than the abrasive itself. Direct inspection of an abrasive powder, paper, or cloth however, will reveal much about its fineness, uniformity, and sharpness of particles.

The problem of illuminating metallic and other surfaces during microscopic examination is not as difficult as it may seem at first glance. Only reflected light can be used to illuminate the object. A 60-watt lamp, properly shaded to keep direct light from the eyes, will do in many instances. Place it so the light strikes the surface obliquely. A small photographer's spotlight makes a good illuminator. One of the most versatile sources is a pocket flashlight, preferably one having adjustments to produce a sharp or a diffused beam. Vertical illuminators of the type used on metallurgical microscopes can, of course, be used when available.

Cutting edges of tools are of paramount importance in the shop. If the edge is keen and smooth, good work results; if not, the work may require additional operations or may even be spoiled. With a microscope placed near the grinder (but protected from grit and dust), a tool edge can be checked quickly. Usually the magnification need be only 10 to 50 diameters. The cutting edges of lathe bits, planer and shaper bits, milling cutters, chisels, wood planes, jointer knives, files, saws, and a score of other tools can be kept in better shape simply by checking them microscopically after sharpening or when they are being sorted.

The woodworker will find a microscope useful for inspecting cross and longitudinal sections of various woods. A plane having a sharp bit set for a very thin shaving will produce suitable sections. The microscope makes identification of woods a certainty; it will reveal, for example, whether a piece is true black walnut or one of its numerous imitations.

The grinding-wheel spark test is an old standby for identifying steels; but a more reliable way is to examine with a microscope the pellets found in grinding-wheel dust. When steel throws down sparks, the particles of glowing metal, upon cooling, form little balls or pellets. These are collected easily in an envelope held in the spark stream near its outer end. Shape and surface appearance of the pellets are determined by the composition of the metal, and once the appearance of the pellets thrown down from a certain alloy is known, that alloy usually can be recognized thereafter by an examination of its spark dust.

Cracks and fractures in metals are additional fodder for the shop microscope. Often a microscopic examination of an important machine part will reveal a fracture that otherwise would have gone unnoticed.

A microscope giving higher magnifications, say up to 1,000 diameters, is useful for checking the quality of fabrics, paper, leather, and other raw materials.

A large field for the microscope in the shop is the examination of the crystalline structure of metals, but this is a process too lengthy to be treated here, involving as it does the careful polishing and etching of the metal surfaces to be examined.

Whatever the job you give your microscope, take pains to protect it from dust and gritty particles. Keep it in a dustproof case or covered with a glass bell jar or cloth hood when not in use. A cloth jacket can be fitted about the tube and stand to protect the focusing mechanism from dirt if the instrument is to be used for long periods near a grinder or other machine that throws off dust. When a lens surface accumulates dust or other dirt, do not wipe it vigorously with a rag! Instead, blow off the loose particles with your breath and brush the glass gently with a small, round, artist's brush at the same time blowing to drive the loosened particles away. Finally, use a piece of lens-cleaning tissue or a soft, clean cloth to wipe the surface; and *wipe*—don't scour—the glass.

Invasion!

[*Continued from page* 104]

and for the soldiers pegged into holes. The dial and spinners are best made on a separate wooden disk. As designed here, there are five officers and twelve privates. The latter number can be increased to prolong the game if desired.

Ships, barges, tanks, guns and pillboxes are carved from soft pine as illustrated and painted olive drab. A larger number than those indicated may be used to add to the interest.

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Mr. Turtle Isn't Rationed!

[*Continued from page* 113]

under water. If you have several turtles which you wish to save for use as required, transport them in your car in a stout box with a hinged stapled top, or carry several of the muzzles shown and fit each turtle with one before throwing it in the trunk of your car.

The safest procedure is to get his head off as quickly as possible with a hatchet or camp, ax, holding him by the tail with his protruding head extended over a log or block of wood while you strike the blow.

With the head off, chop the claws off, too, and you're ready to remove the meat. I've found that having a pail or tub of boiling water to immerse the beheaded turtle in for about 15 minutes makes skinning easier, although it is not absolutely necessary. Use a sharp knife to cut through the skin close to the shell at each leg, then commence pulling the skin back, severing it from the flesh beneath as necessary, and continuing until it comes off inside out in one piece over the paw. With the four legs skinned out feel with your knife blade along the lower shell where it is attached to the upper, and you will locate a soft spot on each side that can be easily cut through to free the shell. Then lift one side of the lower shell and cut it entirely away from the flesh beneath. The meat is now exposed and the four quarters can be cut out first. Then cut out the chunk of meat at the base of the tail, after severing the outer part from the vent back for discarding, finally cut the neck off close in the upper shell. This gives you the best of the meat and has the advantage of leaving all the entrails untouched in the upper shell for burial or disposal. If the turtle is a large one the tenderloins will have enough meat in them to warrant removing, being considered the best of the flesh. The entrails must be scraped out of the shell first, when the tenderloins will be plainly visible under a series of ribs. These must be cut through with your knife to remove the two long strips of meat. This way your turtle will yield three distinct colors of meat claimed by oldtimers to have medicinal value—the neck and two tenderloin strips are light meat, the four quarters dark, similar to the light and dark meat of a chicken, and the tail meat medium light.

Carefully clean away all fat, and the meat is ready to prepare in any of the following ways you choose:

Turtle Soup

Turtle soups can be made in several ways, but the simplest is probably the best. Which means merely using the turtle meat instead of beef in any old-fashioned vegetable soup recipe. Those who like to cook with wines will want to add sherry.

Fried Turtle

For this and other recipes first soak the meat overnight in water (enough to cover) to which has been added ¼ cup vinegar and 3 tablespoonfuls of salt, washing in clear water and drying before using the following day. The meat should be clean and free of all fat, then browned in beef suet or butter. Pour off the grease from browning, season, add a few bits of onion, then cover and allow to simmer until tender.

Baked Turtle

Tenderizing by soaking overnight as mentioned above may only be necessary when the turtle is large enough to be considered old. Dip each piece of fat-free washed meat in lemon juice, then in beaten egg; salt and pepper and roll each piece in a mixture of two-thirds flour and one-third cornmeal. Place the pieces in hot fat (do not use the fat of the turtle) and brown thoroughly. Then put in a roaster pan or other heavy covered utensil with an inch of water in the bottom to prevent sticking, place the cover on and bake until the meat is tender, adding water as required in the meantime.

Curry of Turtle

The meat is cut in cubes and browned in butter along with two onions. A diced potato and a carrot, parsley, salt, pepper and ½ teaspoonful of curry powder is added and the mixture simmered a short time until tender. This is usually served poured over molds of cooked rice.

Turtle and Chicken Pie

Parboil the meat of a small or medium-sized turtle until partially tender and place with the meat of a 2-pound chicken cut in pieces as for frying. Or substitute veal for the chicken, if desired. Put in a baking pan, add three or four medium-sized potatoes sliced fine and a finely cut onion, then add liquor from parboiling turtle with enough water to cover. Sprinkle with flour to make gravy, then cover with bits of salt pork cut fine, or butter, and salt and pepper lightly. Next make a rich biscuit dough, cut in long strips and place over the ingredients. Put in the oven and cook until the biscuit dough is well done, then remove from oven, cover pan with a lid and put on stove to finish cooking.

Mr. Turtle is yours for the taking without closed seasons, ration points, priorities or other restrictions. Try his meat once and whatever way you've prepared it you'll agree its tenderness and flavor are all that can be desired.

Mister—you're getting paid in DYNAMITE!

OUR PAY ENVELOPE today *is* dynamite.

The wrong way to handle it is for us to wink at prices that look too steep . . . telling ourselves we can afford to splurge.

We *can't* afford to—whether we're business men, farmers, or workers. And here's why:

Splurging will boost prices. First on one thing then all along the line.

Then, wages will have to go up to meet higher prices. And higher wages will push prices up some more . . . faster and faster.

The reason this can happen is that, this year, we Americans will have *45 billion* dollars more income than there are goods and services to buy at present prices.

That's the dynamite!

The RIGHT way to handle it . . . and why

Our Government is doing a lot of things to keep the cost of living from snowballing.

But the real control is in *our* hands. Yours. Mine.

KEEP PRICES DOWN!

It won't be fun. It will mean sacrifice and penny-pinching. But after all, the sacrifice of tightening our belts and doing without is a small sacrifice compared with giving your life or your blood in battle!

Here's what YOU must do

Buy only what you absolutely need.

Don't ASK higher prices—for your own labor, your own services, or goods you sell.

Buy rationed goods only by exchanging stamps.

Don't pay a cent above ceiling prices.

Take a grin-and-bear-it attitude on taxes. They must get heavier.

Pay off your debts. Don't make new ones.

Start a savings account. Buy and keep up adequate life insurance.

Buy more War Bonds.

If we do these things, we and our Government won't have to fight a postwar battle against collapsing prices and paralyzed business.

Use it up
Wear it out
Make it do
Or do without

This advertisement, prepared by the War Advertising Council, is contributed by this magazine in co-operation with the Magazine Publishers of America.

Buick "Roadmaster" Coupe

[*Continued from page* 125]

streamlines. The work of different craftsmen may vary slightly, but follow the boat builder's rule of forming natural curves only, without any awkward lines.

The seats may now be glued in permanently. Make the footboard complete with brake and clutch pedals and foot throttle as in Fig. 13. This is a wedge-shaped block, with pedals of sheet metal soldered to pieces of bent wire which are pushed into the wood. The foot throttle is a strip of tin. Hand brake is a curved piece of rod with a tin strip soldered on door ratchet release. For the steering post, use ¼" dowel with a disk on the upper end to which the steering wheel is secured with an escutcheon nail. The wheel, Fig. 15, is 1⅝" dia., made of heavy wire rim, an inner ring of finer wire, and a tin spider having three spokes, all soldered together. You may make the instrument board as elaborate as you wish, with various dials and radio set, Fig. 16. Dials can be of bristol board with figures in black ink, covered with celluloid.

For the windshield, cement celluloid inside, or on the rear side, of a tin frame cut as in Fig. 17, with a hardwood top frame and the mirror a bit of tin or burnished steel soldered to a brad which in turn is soldered to the middle frame member. All soldering, of course, should be done before the celluloid is cemented on. Small brads soldered to the bottom of the frame are pushed into the wood of the body.

Wheels are lathe turned from close-grained wood to the dimensions given in Fig. 18, and secured to the square-section wooden axle. Paint the treads black, sidewalls white, and if available, use a highly polished convex metal button for the cap. To be effective, the bumpers should be of burnished steel or pieces of scrap aluminum which may have escaped the drive. These are made as in Fig. 19, and secured to the body with bars set in holes drilled for the purpose. Handles are made of bicycle spokes to which a collar has been soldered, as in Fig. 20 and tail lights can be fashioned from a short piece of aluminum tubing, using a small red bead for the light, as in Fig. 21. Headlights, if you cannot locate small lenses to suit, can be made of polished metal buttons, similar to those used for hubcaps. The cover for the non-existent folded top is either black or khaki-colored cloth of fine weave, hemmed and tacked to the body over cotton batting with escutcheon nails, Fig. 22.

Your car is now ready for painting, and a lustrous black lacquer is recommended. Of course, the wood must be smoothed with fine sandpaper, filled and given applications of lacquer as per the directions for whatever brand you use. Paint the inside of the cockpit tan, with seats of the same color, and a touch of red on the wheel disks. After the painting is completed, the radiator grille is installed. If you are an expert in tin work, make it of that material. If you doubt your ability to do a neat job, cement on strips of tin foil for the grille as well as the bands along the body.

Experts in model building will be able to elaborate greatly on the details as illustrated in the photographs, but as drawn and described in this article, construction is for the average home craftsman.

"Do we have a washroom?"

Ideas For Service Men

[*Continued from page* 117]

draw strings at the openings. He packed all his socks in one, his fatigue clothes in another, etc., until he had everything in small, easily handled packages that fitted snugly in his GI kit bag. Each package he labeled with India ink. When he wants something he simply draws out the desired bag without fuss, bother or having to sort through the whole contents.

See youse guys next month!

SERVICE MEN, ATTENTION!

This is your department, and if you like it enough to want to make it better, you can. It's all up to you! Send in your ideas—anything you think may help your buddies in the Army, Navy or Marines. You'll be helping yourself, too, because MECHANIX ILLUSTRATED pays from $2.50 up for material used. Address "Ideas for Service Men," MECHANIX ILLUSTRATED, 1501 Broadway, New York 18, N. Y.

Death Missed Four Times

[*Continued from page 37*]

but I wasn't taking chances. We got up and ran outside. The siren started again and we could hear planes overhead getting closer.

"I started to run toward the beach. There was a native hut close by and I was nearly there when the first stick of bombs came down. I fell flat, tried to bury my head in the earth. The explosions close by were deafening. One bomb got that hut. Splinters of woodwork splattered around me like rain. I don't know how that one missed me, it was so damn close.

"We got a twenty minute respite. Then the planes came back again. I decided the space between the square steel tanks wasn't so good—I went up the beach and dug myself a foxhole. Jap bombs started landing close by. I lay there and tried to think of my wife. If this was it, there wasn't any better way to go out—thinking of her.

"About seven that morning, the second all clear came. We started adding up the damage. Some of the officers and enlisted men were dead. None of our flight group.

"That was the second time death missed. All of us were on edge afterwards. Walking toward Headquarters with a couple of friends, I dropped my helmet. Everybody jumped back at the clatter.

"Later those planes that had been damaged were repaired. It was just a few days from the time Thumper—that's the name of our ship—took off to the time we got back.

"But those few days I'll never forget. Wake, compared to that first deal, was almost routine. It becomes a matter of business, you understand. You go out to do a job and just hope to hell you get back. The hoping is part of the job.

"I had a leave finally. It wasn't very long and I had to get all the way to Boston. When I got to the States, I managed to get a ride in a transport flying east.

"We got half way across the country and they threw me off the plane—too much cargo and too little space. I waved so long to the fellows on board. Two hundred miles further on, that plane cracked up. Everyone on her was killed.

"That was the third time."

* * *

The story should end here. That was how he told it. But the game goes on.

I saw Don a few days after we reached our base. "My crew," he said. "They were killed. The pilot and Ernie Moore and all of them except myself and one other fellow who was grounded with a cold. They were raiding Wake, you understand. Cracked up in the sea. Not Thumper. They were flying some other ship. If I'd got back a day or so sooner—"

If he'd got back a day or so sooner, he'd have been with them. For Don, death missed the fourth time, too.

The manufacturing might of all America is concentrated on producing for victory. In the front rank of this vast industrial army are the machinists—and their weapons are tools!

In plants everywhere throughout the nation machinists are busy at every phase of their craft—helping to turn out more, faster, with tools by Disston. Some of the machinist's tools supplied to industry by Disston are the files used every day in general machine shop work, Superfine Swiss pattern files for precision work, file cards, hack saws, hack saw blades, metal cutting hand saws, metal cutting band saws, solid and inserted tooth metal cutting circular saws, metal cutting sabre blades, tool bits, machinist's chisels and others.

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HENRY DISSTON & SONS, INC.
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[*Continued from page* 120]

is 90°, the Reciprocal True Course is 90° plus 180° or 270°.

If the True Course is 200°, the Reciprocal True Course is NOT 200° plus 180° which is 380° (and there "ain't" no such animal because courses are measured from 0 to 360 and so 360 is the largest we can have) but, in this case, 200° minus 180° or 20°.

A good rule to remember is this: To find a Reciprocal True Course or course back, add 180° if your True Course is less than 180°, and subtract 180° if your True Course is greater than 180°.

In the second diagram where the original True Course is from B to A, the Reciprocal True Course will be from A to B.

Having determined our True Course on the map, the next step is to determine what compass reading we must use to make good that True Course. Our compass is subject to a number of errors, and the first one we'll consider is *Variation.*

The earth rotates on an imaginary axis the ends of which we call the poles, North and South. These are the *Geographic* Poles, the ones through which the meridians pass. The Geographic North Pole is the True North Pole we have just used to determine our True Course. Our magnetic compass, however, does not point to this True North Pole but to another pole called the *Magnetic North Pole* which is a large deposit of iron ore located in Hudson Bay in northern Canada. This fact that the compass does NOT point to True North is the error known as Variation. The angle between the direction in which it *does* point and True North is the Variation angle. This value changes from place to place on the earth's surface as the relative positions of the two poles change.

Variation is termed either *Easterly* or *Westerly.* From our position on the earth, if the Magnetic North Pole appears to be to the east of the True North Pole, the Variation is said to be *Easterly,* or just plain *East;* if to the west of the True North Pole it is said to be *Westerly* or *West.* To help the pilot determine the Variation for his particular locality, there are included on his flight charts a number of lines composed of red dashes and labeled in the map margin "15° W" or "21° E," etc. These lines connect places having the same Variation and are called *isogonic* lines. The line of 0° Variation is called the *agonic* line. A chart showing some of the isogonic lines of Variation for the United States is shown at the bottom of page 119. The limits of Variation for this country are from about 20° East to 22° West. Notice that the isogonic lines are not perfectly straight but are very irregular. This is because local deposits of ore affect Variation. Notice also that the agonic line (line of 0° Variation) crosses our country from Chicago, Ill., down to Atlanta, Ga., approximately.

Now to make the correction! If the needles of our compass pointed toward True North, our True Course would be the angle by which to fly. Since they point toward Magnetic North, we shall have to use the angle between Magnetic North and the direction of our course. This angle is called *Magnetic Course,* our course measured with reference to Magnetic North.

Look at the four diagrams at the top of page 120. The first shows a True Course; the second shows the Variation angle (West in this case because Magnetic North is West of True North). It can be seen in the third diagram that to determine the angle between the Magnetic North direction (the direction in which the compass needle points) and the direction in which the pilot desires to travel (True Course), the Variation angle must be *added* to the True Course angle. In a similar manner it can be shown that in the case of Easterly Variation the angle must be *subtracted* from the True Course to obtain the correction. Here is the rule: add Westerly Variation and subtract Easterly Variation. "West is best (add); East is least (subtract)."

In our original problem we had a True Course of 45°. To determine his Variation correction, our pilot will look on his chart and find the isogonic line which crosses his course. If there are two of them, he will take the one nearest to the center of his proposed journey. In the map margin he will find the value of that isogonic line and use it as the correction, remembering to add if West and to subtract if East. If in our problem it is 15° West:

T. C. (True Course) = 45°
V. (Variation) = 15° W (West)

M. C. (Magnetic Course) = 60°

If it is 15° East:

T. C. = 45°
V. = 15° E.

M. C. = 30°

The second compass error, *Deviation,* is caused by the disturbing effect on the compass needles of magnetism in the plane itself: the metal motor, electrical instruments, electric wiring, etc. These tend to pull the compass to the East or West of the direction in which it should point, which we agreed was Magnetic North. The sketch on the bottom of page 120 will help to explain this situation.

Deviation also may be either Easterly or Westerly, Easterly if it pulls the compass to the east of Magnetic North and Westerly if it tends to pull the compass to the west of Magnetic North. The value of Deviation is represented by the angle through which the compass is pulled. Here, too, "West is best and East is least"; Westerly is added

[*Continued on page* 144]

"Phooey On Ration Points"

[*Continued from page* 40]

will get together and buy a piece of machinery which they share equally.

Years ago, some of the students got together and organized the Independence Foundation. They borrowed enough money to buy forty acres of farm land which they divided into one- and two-acre plots and utilized co-operatively. Since the land was bought in such large quantity, it was obtained wholesale, and the cost of individual plots came to very little. Each member then received one of the individual blocks of land and simply paid his share of the carrying and amortization costs to the association which owned the land. This came to from $5.00 to $7.00 a month.

The members moved in immediately and lived in tents while their houses were being built, most of which were in cumulative units, starting with one room, kitchen and bath, and designed to grow with the needs of the family. The average total cost of one of these basic unit houses was $2,698.

New Yorkers with moderate incomes who could barely afford $45.00 a month rent, suddenly found that they could afford virtual estates in the country and soon many such projects were organized. The members make their monthly payments until the loan for the project has been repaid, after which they own the land and can either keep or dissolve the association as they see fit.

Many people who own small pieces of land and wish to develop them, come to the School of Living for advice and experience. To these people, Mr. Templin has this to say:

"Don't become too ambitious and attempt too much in the beginning, though the temptation to do this is great. It is better to garden only a small space well at first, and thereby become familiar with your gardening problems. For the rest of the space, put in a cover crop, such as legumes, soy beans, alfalfa, or cow peas, most of which will be later plowed under to enrich the soil for the next season's crop. Can and process all the surplus food you raise. Expand gradually as you become adept at each phase of homesteading. You can get a cow or a goat—later, a few chickens, maybe rabbits, which are very profitable for food and fur, pigs, bees, etc. In each case, wait until you are thoroughly familiar with and capable of tending to what you have before making new additions."

Soil care receives great emphasis at the school. Mr. Templin builds composts, which are tall mounds consisting of alternating layers of vegetable waste, manure, quick lime, and earth. In from 6 to 12 months, these composts decompose into mounds of rich black humus, which he mixes into the soil before planting. In this way, the soil is fed what it needs, and its mechanical texture is kept more suitable for plant growth. There is no fear of soil erosion, and, as the years go by, the soil becomes richer and yields better harvests.

Dear Jim:

You ought to see

the interest in motorcycles around here. When our outfit comes in from maneuvers the fellows all crowd around asking questions and begging rides. Believe me, our Club is going to have plenty of new riders after the war.

These military Indians are honeys! They take punishment like regular champs -- and they're easy to handle and safe, just as Indians have always been. Wish I could tell you about the new Indian improvements, but military secrecy won't let me. Regards to all the Club members.

INDIAN MOTOCYCLE COMPANY, SPRINGFIELD, MASS.

Indian

BUY WAR BONDS NOW

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[*Continued from page* 142]

to make the correction and Easterly is subtracted. Every time a plane is pointed in a different direction, there is a different setup between the compass needles and the magnetic influences in the plane and hence *a different Deviation correction.* This is an important fact to remember! Deviation depends upon the direction in which the plane is pointed; Variation depends upon the location of the plane on the earth's surface.

When the manufacturer or a licensed mechanic installs a magnetic compass in your ship, he mounts on the instrument panel near the compass a small card such as the one shown on page 119. It is called a *Compass Deviation Card* and tells you the Deviation correction for your Magnetic Course. The values on this card are determined by trial and error by the mechanic in a process called "swinging the ship." He takes the plane, completely equipped, to the center of the airport where it will be free from outside disturbance, raises the tail to flying position, starts the engine and tests the compass in the various directions, compensating it as much as possible (as described in Lesson 8) and filling out the card.

Look at the card and we'll determine our Deviation correction. In the column headed "For" we find our Magnetic Course of 60. Beneath it we find in the "Steer" column the number 61. This means that 1° has been added to our Magnetic Course. The correction, therefore, is 1° West (because it was added) and the course we fly is 61°. This is called our *Compass Course* because it is the angle between the compass needle and the direction in which we desire to travel. On the card we can see that for a Magnetic Course of 30° we would steer 31°, the correction being 1° West in this case also.

Should our Magnetic Course have a value not shown in the "For" column of the card, we would use the correction for the nearest value shown. For example: 140 is near 150 in the "For" column. The correction for 150 is 3° East (150° minus 3° = 147°) and that correction applied to 140° will give us a Compass course of 137°. The Deviation correction is illustrated in the fourth diagram at the top of page 120.

Our final correction is for wind drift. A plane flying in a wind which is neither a direct head wind nor a direct tail wind will be drifted from its course as shown in the diagram at the right on page 121. Correction is made for drift by *heading the plane into the wind the proper amount* so the plane will stay on course. As shown at the bottom of page 121, when the wind is from the *right,* the track (actual path) of the plane will be to the left; in other words the plane will have a *Left Drift Angle.* Correction is made by heading the plane into the wind (to the right) at an angle known as the *Wind Correction Angle.* With a wind from the left, the plane will drift to the right (*Right Drift Angle*) and the angle for correction will be a **Left Wind Correction Angle.** Here, briefly, is the story:

Wind from right: **Left Drift Angle;** Right Wind Correction Angle.

Wind from the left: **Right Drift Angle;** Left Wind Correction Angle.

Looking at the diagram at the top right of page 121 we can see that when a plane is headed to the right of its original direction, its course is *increased.* With an original course of 60°, heading the plane to the right through an angle of 30° will increase the course to E or 90°. In a similar manner it can be seen that to head the plane to the left has the effect of decreasing the course. From these we can derive the rule: wind from the right—add the W. C. A. (Wind Correction Angle); wind from the left—subtract the W. C. A. Our result is the *Compass Heading,* the angle between the compass needle and the heading of the plane. Remember that the Drift and Wind Correction Angles are not the same. The Drift angle is obtained by a plane in flight by means of the drift sight; the W. C. A. is obtained by means of the wind diagram or with a computer, methods which we'll discuss next time.

To summarize, here's the entire problem so far, just addition and subtraction.

T. C. (obtained from chart)
V. (add if West; subtract if East)
M. C.
Dev. (add if West; subtract if East)
C. C. (Compass Course)
W. C. A. (add if Right; subtract if Left)
C. H. (Compass Heading)

Such a problem is shown at the top of page 121. In our problem we had a C. C. of 61°. Should we find that to stay on course we shall need a W.C.A. of 14° Right, adding we arrive at 75° which is our Compass Heading, *the reading we must follow on our compass to reach our destination.*

Remember the order of corrections and the definitions. The letters TVMDCW form the first letters of the words, "Tell Vera Mike Didn't Call Wednesday" and memorizing this sentence will be of help.

The next time we shall study the reverse of this problem: how to find your True Course from your Compass Heading. We shall have a number of explanatory problems, also, and the W. C. A. itself and the wind diagram will be the topic of discussion. There is no Question Box for this lesson, but the one at the end of Lesson No. 11, *Solving the Drift Problem,* in December MI will cover the entire dead reckoning problem.

The tiny hummingbird can make a nonstop flight of 500 miles.

Marks of raindrops have been found in rocks millions of years old.

William B. Stout's "Skycar"

[*Continued from page 48*]

became chief engineer of the newly formed aircraft division of the Packard Motor Car Company and worked on a plane to be powered by the new Liberty engine. After the United States entered World War I, he was called to Washington as technical adviser to the Aircraft Production Board.

Stout's unorthodox ideas on airplane construction gave the Army big-wigs technological colic. He insisted that the exposure of struts, wires, radiators and landing gear increased wind resistance. He cited the DeHavilland 4, in which, he maintained, 237 of its 400 horsepower were wasted. If, he argued, the wing of a plane is the only part that lifts, then build thick wings with all the bracing structure inside.

The Army engineers sputtered and fumed, but, after many delays, Stout was given a contract to build the plane on a cost-plus basis. When the plane was built they threw up their hands in horror. Orville Wright, called in to check it, declared, "This is the next step in aviation."

But the Navy was interested enough to give Stout an order for the construction of the first all-metal torpedo plane. It was completed with the financial backing of Robert Stranahan, who had already sunk money in the Batwing experiment, and Eddie Stinson made twelve successful test flights at Selfridge Field, but a Navy pilot, unfamiliar with the landing mechanism, crashed it.

That crash broke Stout financially, but it did not dim his courage. He still had his typewriter. He banged out a letter which he sent to 100 leading businessmen, explaining it was the first of a series demonstrating the principles of flight. Enclosed was a post-card with the suggestion that the reader attach a paper clip to one edge to show that the center of gravity is at the center of air pressure. "Do this experiment personally," the letter suggested, "and it will teach you more in half an hour than a month's book reading. If you have any trouble getting true flight, call me up and I will bring over my trained card and clip and show you how it is done."

Stout asked the recipients of the letters to contribute $1,000 each for the construction of a commercial all-metal plane. "You may never get a cent of your money back," he warned, "but you will have one thousand dollars worth of fun. It's a gamble, but you can afford it."

More than sixty of these men responded favorably and gave Stout $118,000, with which he founded the Stout Metal Airplane Company. The result was an all-metal eight-passenger transport plane powered with a Liberty engine. He had built fifteen of these planes when Henry Ford, one of the original backers, offered to buy the company on a basis of two for one. The stock-

[*Continued on page 147*]

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JOHNSON SEA-HORSES for DEPENDABILITY

Emergency Power Packs

[*Continued from page* 129]

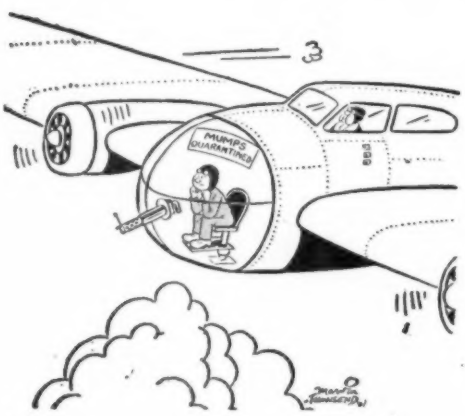
an old but good Model-T Ford spark coil (Fig. 2). Better yet is the secondary of any low tension auto coil since the resistance is less and thus more current will be passed. Condensers each side of the choke can be had by using the two contained inside the casing of the Ford coil. These are about 1 mfd. each. Larger capacity condensers, of course, will smooth out the ripple to a greater degree.

Fig. 3 shows how an emergency power transformer can be set up from two unused audio transformers of rugged construction. Tie the two primaries in parallel and connect the secondaries in series. If they are of a 3 to 1 ratio, nearly 350 volts of unrectified current can be obtained. Rectifying and using the center tap, approximately 150 volts of D. C. can be realized, and good transformers will stand a drain of at least 40 mils, sufficient for any average receiver.

In lieu of a bleeder (Fig. 4) a common, low candle-power carbon lamp can be used across the output. Several of them in series will provide a higher resistance and the right valve can be determined by trial.

Extra filament lighting or rectifier-tube lighting transformers can be had by using bell ringing transformers where the current drain is small. Even toy train transformers can be utilized. Check the drain of the tubes with an ammeter. If the voltage still remains too high, insert a resistance in one or both legs of the line. Several taps make this voltage approach a simple matter (Fig. 5).

Another way to raise the voltage output of either a power or filament transformer is shown in Fig. 6. Wind about 50 turns of No. 16 well-insulated wire around a 1" form. Connect this into one side of the 110-AC line to the primary. Check the normal output with a voltmeter. Then slowly insert a large iron bolt into the form and watch the voltage rise. This is useful in raising the voltage from a source too low for use.



Long-Wave Reception

[*Continued from page* 128]

socket and the second audio was a 2A5, also using a 6-prong socket.

Because of the fact that a screen-grid detector was used, the first audio transformer was removed and an impedence-coupled affair replaced it. The second stage transformer is used as usual. Arrange for a removable grid-leak so various resistances may be tried. Clearness and quality of reception depend upon this.

For the coil, a 4-prong socket was placed conveniently on the base and wired into the circuit. The coil itself was wound on an old variometer form 8" long by 3" in diameter. Across the bottom end was fitted a piece of thin wood in the center of which was bolted a sawed-off tube base as indicated. This particular coil was wound with 400 turns of No. 28 DCC wire and tapped in three places after experimentation. The shortest tap allowed just the top of the broadcast band to be heard. The other taps were divided equally along the top section of the windings. To the grid lead of the detector tube (a flexible wire) was attached a clip for clipping to one or the other of the coil taps, thus reducing the number of turns. Where the detector tube cathode is tapped into the bottom of the coil L1, not over 15 turns from the bottom of L1 are used. This is important.

Regeneration is controlled by the screen-grid voltage adjusted by variable resistor R2. If a fringe howl develops, shunt the transformer secondary with a ½ to 1 meg. resistor.

Weak signals may be due to antenna length. If you have an extra long wire, 150' to 200', it may be that C1 is necessary. If the antenna is short then C1 can be dispensed with and the antenna connected directly to L2.

Building such a receiver is very much a matter of experimentation, and some of the factors given may have to be changed to suit conditions. Use from 200 to 250 volts of B power, regenerate carefully with R2 so a quiet hiss is heard in the speaker. Its lowest point will be the most sensitive. Use good tubes and a *good* ground.

Wood-Scrap Craft

[*Continued from page* 115]

½" and ¼" stock and one ⅛" dowel. Cut the sections as shown in the squared drawing and nail together. Fasten two loops of tin or other material to the underside of the lid, slip a ⅛" dowel through these and glue it into the front and back. This dowel acts as a hinge for the lid. Stain the box and paint the floral design with enamel.

Two little wooden men who hold a whisk broom between them are drawn on paper first, then traced to 1½" stock and jigsawed out. Cut the two arm sections from ½" stock and nail them on each side of the figures; then cut the base from 1" stock, drill a 1¼" hole ¼" deep in the center, and fasten the base to the figures with screws.

William B. Stout's "Skycar"

[*Continued from page* 145]

holders demurred, but finally agreed to go along with Stout in the development of the Stout Air Services, which in four years carried 200,000 passengers between Detroit, Grand Rapids, Cleveland and Chicago without a single fatal accident, until it was bought by United Air Lines.

In 1935 Stout rocked the automobile industry with the sensation caused by his Scarab car, which had a streamlined body that looked like a giant beetle, with the engine in the rear and wheels independently sprung. It had no running board, rode on special cushions, and the interior suggested a living room. Its appearance was so startling that people would ask, "Which way is it going?"

The Scarab was not a financial success (Stout made only nine of them), but almost every one of its features has been incorporated in today's cars.

Forced into other fields to make money, Stout built the first streamlined, lightweight, high speed, gasoline-driven fifty-passenger Railplane for the Pullman Company, which the railroad men then shelved. He designed the exterior of the Union Pacific's famous streamlined M10001, which runs between Chicago and Denver. He built a streamlined rear-engine bus which he sold to the Gar Wood Company. He built a theater seat which slid back to let a person pass. He constructed a brick-loading machine and an air-conditioned bed.

It has just been announced he has joined Consolidated-Vultee to work on research for light planes to be built when this war has ended. Stout sees a future of flying autos and trucks, planes which fold their wings on alighting and run along highways on their four-wheeled landing gear. He sees helicopters of new design which will fly straight up, forward, backward, and sideways, landing on rooftops, lawns, tennis courts and parking spaces.

Consolidated-Vultee has already presented for public consideration three models: the Aerocar, or flying automobile for family tours and trips; the Roadable airplane, for distance flights coupled with short trips on the ground; and the Helibus a new type of helicopter, so versatile that in addition to moving in any wanted direction it will stand still in the air and land on a tennis court.

Stout believes that the greatest progress in automotive and plane construction will come, postwar, from the aviation industry, which is not, like the automobile industry, bound down and hampered by a tremendous investment.

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The MI Record Changer

[*Continued from page 127*]

only 13/16" long to take the ¾" end of the record support leaves. The lowest slot, however, is 1 1/16" as this slot takes the selector leaf (part 5, Detail C) which is 1" wide throughout its length. The right and left ends of the housing are bent as indicated, and, after the leaves are inserted (Fig. 2), they are riveted together or bolted with 6-32 machine screws. The diagonal stiffener brace (part 3) was added to increase rigidity. The lower ends of the housing are drilled and bent as indicated for attaching to the mounting board of the record changer. In cutting the guide slots, the metal at the center of the slots is cut away for ease in operating the saw.

The *record-support leaves* (part 4, Detail B, Fig. 1) are essentially all alike with the exception that the "fingers" at the left end are arranged as shown in Fig. 2 so that loading the magazine is simple. In operation the leaves are advanced to loading position by pushing forward on the "fingers," the lowest leaf (which must be loaded first) having its finger outside, the next lowest leaf having its finger next, and so on. These fingers are arranged three on each side rather than all on one side so that none will extend beyond the edge of the housing. The "teeth" of the record-support leaves which are engaged by the push-rod (part 7, Detail C) are formed simply by bending down slightly a right-angle cut in the edge of the leaves at the position shown.

The *selector-leaf* (part 5, Detail C) carries the push-rod assembly and is the means whereby the record-support leaves are withdrawn one by one to permit each record to drop on the turntable. It is with this part that the ingenuity of the workshop fan may be expressed. The device shown seemed to require a minimum of working parts, and is especially simple to construct. More will be said of this when describing its operation, but first let's dispose of the cam-arm.

The *slotted cam-arm* (part 11, Detail D, Fig. 1) was laid out to fit the condition under which this particular magazine was used and covers the relative positions of the changer shaft and magazine as shown in Fig. 2 arrangement plan. The radii of the cam, however, can be readily determined if these relative positions do not prevail. The longer of the two radii (R) is the center to center dimension from the changer shaft to the pin (part 6, Detail C) when the selector-leaf is in extreme advanced (loaded) position. This slot provides the time interval required by the phono pick-up to raise and clear before the record is dropped from the magazine. The shorter radius (R') may be found by trial and error, but is actually the distance measured on a perpendicular dropped from the center line of the changer shaft to a parallel center line of the selector-leaf pin, which is practically the equivalent of the dimension from the center of the changer shaft to center of selector-leaf pin when the selector-leaf is in its extreme withdrawn position. This can be checked in construction by making a cardboard pattern. The time interval is easily adjusted by retarding or advancing the cam-arm on the changer shaft (13) and once correctly timed is locked with a machine screw and lock washer.

The *"Z" Arm* (part 12, Detail E. Fig. 1) is mounted on the changer shaft (14) opposite the magazine. The edge of the records rest on this arm as shown in Fig. 2. The dimensions are such that only the uncut rim of the record rests on the arm. As a record is released and drops approximately 30 degrees on the magazine side, the edge supported by the Z arm clears and drops. The records remaining in the magazine, being approximately horizontal, remain supported on the Z arm. Stops are provided so that the 10" or 12" leg of the "Z" is turned into exact position. The pulley which is mounted on the lower end of this shaft in the MI record changer must be changed to an idler pulley, i.e. it must turn freely on the shaft as this shaft now becomes merely a supporting shaft for the "Z" arm.

In *operation* this is what takes place:

Assume all record-support leaves are in withdrawn position (unloaded). The first record is placed directly on the turntable. The push-rod (part 7) is depressed to its "cocked" position (extreme lowest position as shown in Detail C) by pushing down on the button (part 9). It is locked in this position by advancing the lowest leaf to loading position. A record is placed on this leaf, its opposite edge resting on the "Z" arm. The next leaf is advanced, and its record loaded, and so on, until the magazine is fully loaded. When the pick-up reaches the end of the first record the changer starts. The changer shafts begin to revolve, the pick-up is lifted and shifted to clear the record edge. During this interval the cam-arm (part 11) has no effect as the radius "R" is such that the slot "rides" the pin (part 6). However, when the shaft has revolved to the point where the short-radius, R', slot reaches the pin, the selector-leaf is forced to withdraw. The push-rod (part 7) engages the "tooth" on the under side of the lowest record-support leaf, withdraws it and the record drops to the turntable. The cam-arm having reached its maximum swing, the changer now reverses, and the selector-leaf and its attached selector assembly is returned to its original position. As it returns the push-rod slides off the front of the tooth and rises to the next record-support leaf due to the spring (part 8). The tension of this spring must be sufficient only to raise the push-rod through its effective total operating height (to the under surface of the top record-support leaf), so that there will be a minimum of friction between the push-rod and record-support leaves. (This spring may be

[*Continued on page 150*]

Continent Of Tomorrow

[*Continued from page 53*]

If you are, *your* fortune lies in *that* direction. You may bank on it, that there'll be plenty of money and capital to pay for ideas.

For all the vast and varied mineral resources that make up 90 per cent of the country's exports, Bolivia is really a "one crop" mineral country. Sixty-eight per cent of her mineral exports is tin. Tin is the chief support of most of the population, the primary source of government revenue.

Despite the fact that Bolivian tin is the United Nations' sole source of this primary war essential since the Japanese conquered the only other important tin mines in the world, Bolivia is by no means in a tip-top state of efficiency to turn out finished tin with the greatest speed and economy. Bolivia never sees an ounce of its own tin—until it is shipped back to the country in the form of tin cans filled with the food she is obliged to import to keep the population from starving! Until only a couple of years ago, every ton of barilla, or tin ore, was taken on a ten-thousand mile sea trip to England to be smelted! That distance and waste was halved by building a big smelter in Texas a couple of years ago.

With so much emphasis being placed on tin, the rich beds of the country's numerous other minerals are being neglected. No one seems to remember that more than two billions in gold were taken out of Bolivia in Spanish times! Now, less than a paltry half million a year is being mined. Frank G. Carpenter, the well-known world traveler, made a journey into little-known Bolivia about forty years ago, and wrote: "Gold is plentiful. It does not lie in pockets, but is distributed through beds of gravel. Large nuggets are frequently found. One of them was sold recently for $11,000."

While we were going to far-off China for tungsten, one of the world's most sorely needed war metals, Japan had learned that Bolivia had plenty of tungsten to sell and was buying it. It was the same with war-precious antimony, wolfram, molybdenum, nickel, cobalt and mercury. Large deposits of chromium had remained undeveloped.

[*Continued on page 150*]

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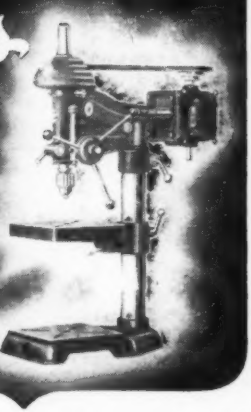

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The MI Record Changer

[*Continued from page* 148]

wound from music wire; a steel guitar G string was used to wind the one used.) This light spring tension permits the push-rod to pass the back of the "tooth" so that it will be in position to withdraw the next leaf which is engaged at the completion of the changer cycle.

It may be noted that no provision has been made to overcome the possibility of the push-rod, on its return trip, advancing the leaf just withdrawn. It was found unnecessary, as the very light tension present does not in fact advance the leaves sufficiently to prevent engagement of the next leaf, and due to the ¼" offset the push-rod withdraws all leaves below the one on which it is directly working. This prevents all possibility of any of the leaves which have previously discharged their record from interfering with the record about to be discharged. Each time a leaf is withdrawn, the push-rod rises to the next leaf and this is repeated until the magazine is completely unloaded.

This device is offered merely as a suggestion and much fun may be experienced by the work-shop enthusiast in adapting the idea to his own needs by re-designing where necessary to fit given space, increasing its capacity or improving the suggested methods. As designed, however, it is easy to build and has, in the writer's case, overcome jamming and chipping and breaking of valuable records.

Welder's Preheating Outfit

[*Continued from page* 130]

heating unit is bent to shape from ⅛" pipe. The three-legged standard is from an old sheep shearing machine easily available at junkyards.

This outfit generates easily and throws a large volume of heat. The adjustable stand makes it easy to direct the flame at any desired point. With an extension handle on the burner, this outfit also serves as an excellent weed burner.

Your Invention Clinic

[*Continued from page* 12]

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Who is to pay you royalty if the idea is not patentable or patented? Perhaps this mysterious item might be protected. Perhaps minor modifications might so improve it that some form of protection could be obtained.

But if you want advice you'll have to let the cat out of the bag so that we can take a look at it to estimate its value. If we think well of it we'll tell no one except you.

Continent Of Tomorrow

[*Continued from page* 149]

Only relatively small quantities of lead and zinc had been exported. It was never generally known that Bolivia could supply the whole world with bismuth!

But that is not half of the story of the Bolivian Utopia.

Only a few hours' journey out of La Paz, you can stand on the edge of the Altiplano and look down into one of the most fertile and prolific tropical regions on earth. This is Bolivia's "other world," Lower Bolivia.

Plant a seed down there and you get a crop. Corn grows without plowing. Potatoes grow wild. Onions, sugar cane, beans can be raised by the ton.

Yet for all this lush tropical abundance throughout Lower Bolivia, Upper Bolivia does not get enough foodstuffs to feed herself.

It seems incredible. But Lower Bolivia with its 500,000 square miles is practically without means of transportation! No railroads, no motor highways, not even wagon roads. Again, there are only a few handfuls of people scattered over the whole area. Farming is being done with the same crude agricultural implements used by the primitive Indians.

Turning from the broad tropical jungles of the northeast, still another rich land of promise covers Bolivia's southeast corner. This is the famous Gran Chaco country. The same promise of abundance is thwarted by the same old problems: not enough people, no adequate means of transportation and only primitive methods offering little chance of development. Here is a boundless prairie land; thousands of square miles of virgin land undeveloped—for the most part not even explored or surveyed.

Cattle, meat and hides go begging. No transportation, no markets, no profit. The bottom can't get to the top. Never the twain do meet!

Why not? Science and invention, up to now, have not been equal to the tremendous task. The people of our America had not awakened to the opportunity.

It took a world war to bring Bolivia and the whole continent of the future to the fore. The loss of the East Indies to the Japanese was one of the most fortunate things that ever happened to South America. We were thrown into each other's arms in mutual military defense and economic interdependence.

The moment the war is over, the big push will be on. There will be an altogether new twist to pioneering. This time it won't be the lumbering covered wagons, but the cargo clippers. They will level the Andes and drop helicopters on any bald spot that promises a reward. In 1941, Bolivia clipped the wings of the last German airplane and made the United States flying free.

All these things are not to be wholly ours for the taking, but for the developing, for the benefit of all.

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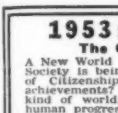

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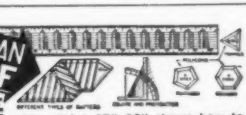

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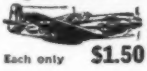

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The Chinese Soldier

[*Continued from page 65*]

only to turn and face the enemy again, until the Japanese chatter in simian rage at the stupidity of a foe that refuses to know when he is licked.

The Chinese soldier fought stubbornly at Shanghai in 1937 in spite of being hammered by Jap naval guns and bombed by Jap airplanes. The Chinese losses averaged one man out of every two. Driven back, he rallied on the new line up river and turned at bay again. Then came Nanking, more heavy losses, more orderly retreat back to Hankow. He finally stopped the Japanese at the deepest enemy penetration into China—1,000 miles from the sea—at Ichang, only some 350 miles from Chungking. With towering mountains and deep gorges behind him the Chinese soldier has retreated no further. From this line, he looks forward to the day of counterattack, the glorious day to come when with sufficient planes and guns, he will exterminate the Japanese like harried rats.

The fighting spirit of the Chinese soldier is housed in a body that by no stretch of the imagination could be called well nourished according to Occidental standards. Instead of the beef, dried milk, vegetables, butter and sugar of the American staple military diet, the Chinese soldier is issued only rice—some twenty-four ounces of it a day, when the rice is available, and the coolie transportation corps can get it up to the front lines. At rare intervals he is issued a piece of pork. Anything in the line of green vegetables or vegetable oil for cooking he has to provide himself out of his pay of twenty Chinese dollars, the equivalent of one U. S. dollar, per month. With such a vitamin-deficient diet, he is subject to swift fatality if struck by disease. If wounded, he is out of luck in most cases. He has no hospital planes to swoop out of the sky and carry him to the base, no ambulances in which to ride comfortably to the hospital, few stretcher bearers to pick him up and carry him to the first aid station, no soothing shot of morphine to dull his pain. His main hope is to be able to walk the fifty or sixty miles to the nearest medical aid. Once there, he is liable to find nothing but the crudest facilities—for the Chinese army has only some 1,500 doctors for its 10,000,000 soldiers!

The Chinese soldier has stoically withstood some 5,000,000 casualties from disease, wounds and death in battle in the six years since the start of the fighting at Marco Polo Bridge that precipitated the "Chinese Incident." But his personal spirit and courage are unquenchable. Slowly that spirit has been deepened into a united patriotism, the greatest fruit of the dragon's teeth that Japan has sown throughout China.

For the conscription of millions of soldiers from all parts of China has merged and brought together the most diverse elements of the widely separated provinces and peoples, speaking different dialects and meeting each other as strangers for the first time. China is beginning to achieve a unity that she has never known in all her thousands of years of history.

That unity is strengthened by the course of training to which the Chinese soldier is subjected. Periods of service on the static battle fronts are varied with withdrawals to the so-called "rest areas." Here the soldier is drilled at grenade throwing, bayonet practice, and inculcated with patriotic fervor and nationalistic doctrine. The soldier's day is started with the raising of the red and blue flag of China, to the singing of the national anthem, followed by the deep-toned shouting, in unison, of the patriotic slogans devised by his leader, Generalissimo Chiang Kai-shek. After drill, the Chinese soldier listens to lectures on the Japanese army and its strength and weaknesses, on the Allies of China and their problems, on sanitation and cleanliness, on tactics and weapons, or his duties as a citizen and a soldier. The Chinese soldier, for the most part, cannot read or write but is instructed while in the Army in the basic Chinese characters, tracing them in the dust and mud for lack of paper. The first lesson in his simple text book reads, "I am Chinese: you're Chinese: he's Chinese: we all love China."

The Chinese military academies are turning out well trained young officers. For doctrine they do not have to follow such modern teachers as Von Clausewitz, Jomini or Foch. They go back to the military wisdom of Sun Tsu, whose book, The Art of War, is the oldest military work in existence. Its maxims, written some 500 years before Christ, in the days of spearmen and bowmen, are equally applicable in this day of contest between guns, planes, and tanks. Says Sun Tsu, among other wise things, ". . . when able to attack we must seem unable; when using our forces we must seem inactive; when we are near, we must make the enemy believe we are far away; when far away we must make him believe we are near. Hold out baits to entice the enemy. Feign disorder and crush him. . . . If he is secure at all points, be prepared for him. If he is superior in strength, evade him. If your opponent is of choleric temper, seek to irritate him. Pretend to be weak that he may grow arrogant. If he is taking his ease, give him no rest. If his forces are united, separate them. Attack him where he is unprepared, appear where you are not expected. . . ." The entire military doctrine of the Chinese soldier can be summed up in those few phrases, especially as they apply to the guerrilla tactics he has so capably developed.

To overcome the lack of equipment which handicapped them in fighting pitched battles against the well-armed Japanese, the Chinese authorities developed one of the most effective guerrilla forces in any nation. The initiative was taken by the Eighth Route Army, formerly communist,

The Chinese Soldier

which took the lead in these activities and roused up and secured the co-operation of the patriotic peasantry in immense areas. Because of the success of these efforts, the national military leaders organized special schools for the training of officers in guerrilla warfare, with officers detailed from every Chinese division to learn the art.

Once trained, these officers were sent out individually to selected areas, each with a small group of trained men, carrying a supply of weapons and explosives and bare needs in other equipment. These groups daringly moved right in under the Japanese-held walled cities and military centers, enlisting the peasants, men, women, and children. Disguising himself as a peasant, the Chinese soldier moved by day undetected by the Japanese, organizing an intelligence service among the old men, the women and children, and enlisting able-bodied men as guerrilla fighters. These operate with deadly results at night, killing Japanese sentries, blotting out small Japanese detachments, wrecking railways and bridges, dynamiting troop trains, cutting telegraph and telephone wires and, in general, harassing the Japanese relentlessly. The fearful punishment inflicted upon communities wherein these activities occurred only angers the Chinese civilians and swells the ranks of the guerrillas. Great bands of them, separated into twos and threes, arrive at a designated point, where they concentrate for a few minutes of deadly work, only to disperse and fade into the darkness again before the Japanese can lumber into action.

In June, 1938, the Chinese Chief of Staff, General Pai Hsung-chi, reported that these guerrilla bands were killing an average of 500 Japanese soldiers daily. The Chinese soldier as a guerrilla fighter undoubtedly has accounted for more Japanese casualties in his day and night maraudings, than the Chinese as a regular soldier has in his occasional battles. The morale of the Japanese Army has suffered severely under this constant sniping, with death lurking in every shadow and stalking them at every step with sudden murder, without quarter, the fate of any Japanese soldier caught alone.

It is from these guerrilla fighters that many of the most skilled officers and men are coming into the regular forces. It will be these guerrilla fighters who will be of inestimable aid to the United Nations forces when at last they fight in China.

The Chinese soldier takes to the tools of modern war like a duck to water. He is animated by a burning desire to kill as many Japs as possible and to get the job over with. But before going back to his farm he wants to stamp through the streets of Tokyo, line up all the Japanese generals before firing squads, exile all lower ranking Jap officers to hard labor abroad, and then occupy Japan.

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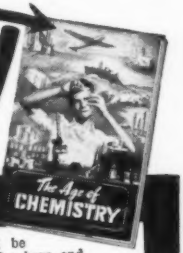

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ABOUT RUPTURE

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Navy Teaches Aerial Gunnery

[Continued from page 44]

on a decision. Upon a snap consideration this practicing may seem ridiculous, but actually, according to the Navy, it is the most important part of modern air fighting. Cards up on the walls all over the station proclaim: "You Don't Begin To Fight Until You Recognize Your Enemy!"

Recognition is almost a religion in the Naval Air Service. They spend hours at it, beginning the first week by learning the general characteristics of four enemy planes a day. They have trick names for these aircraft which mean more than the plane in itself. For instance the Zero is called "Zeke" and the letters in the nickname stand for certain visual characteristics of the plane. Many of these are on the secret list.

The actual gunnery training begins with—of all things—a Daisy air rifle! In a covered stand at Norman we saw a number of young students enthusiastically firing mock-up machine guns into which had been fitted small air rifles. They were learning range and deflection by firing at small cardboard targets set up on a framework only a few feet away. Later they advance to a practical study of laying-off and deflection at a complete skeet-shoot set-up where they pump away under the guidance of individual instructors until they can put up scores worthy of any skeet tournament.

From that they advance to a short period of training during which each student sits in a real power turret and sees on a projection screen Messerschmitts, Zeros and Nakajimas roar at him. This effect is produced by an intricate motion picture device combined with an automatic gun which places a ring-sight mark on the screen at the point where the gunner is aiming at the attacking fighter.

Another training device consists of a dummy turret arrangement in which the student sits behind a large face mask. In his hands he has a set of controls similar to those found on the new Sperry gun-turret and before his eyes an endless film throws a series of moving plane targets on a small screen. Here again he sights on the target, using the knowledge he has absorbed in the classrooms, and "fires" at the enemy.

But eventually the last few weeks of their training roll around and they are at last allowed to fire ball cartridge from .30 and .50 caliber weapons. So far they have enjoyed themselves with air rifles, 45-caliber pistols bored for .22 caliber ammunition and 12-gauge shotgun stuff. Now they load a length of belt ammunition into the feed block of a Browning gun set up on a post and get the opportunity to fire point blank at a fixed target. For the first time they get the thrill of handling a real automatic weapon and learn to time their bursts. From this they advance to a set of butts where they fire at a target whipping across the countryside on a flat gasoline-motored

Navy Teaches Aerial Gunnery

truck which runs on tracks hidden behind miles of breastworks.

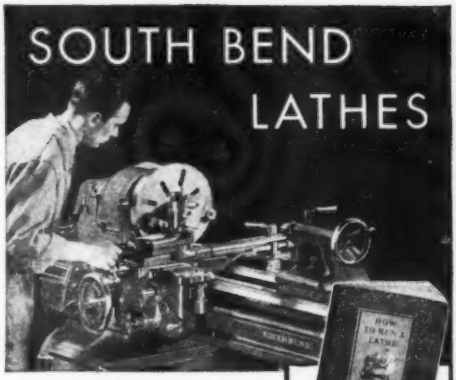
What the student sees here is a large white target racing at high speed over the local landscape, dipping, twisting and turning sharp corners. Here it disappears, here it emerges at a new rate of speed. He uses his sights and as his mind transports him to operational height over Munda he checks range, allows for deflection and fires.

Further along we discovered a number of power turrets mounted on high speed trucks. The trucks were driven over an elliptical course almost parallel to another towed-target set-up. But here the distances were far greater. There was a reason for this. In the turrets we found not .30 caliber weapons but the scowling black destroyers of the .50 caliber class.

In this final lap of his training the Navy student is placed in the Sperry turret and the truck races around the elliptical track. At the same time the target truck begins racing through the hills and dips of the range. It is up to the student to manipulate his guns and turret just as he would were he aboard a Martin "Mariner" or a Consolidated PB2Y-2 flying boat. The gunner faces all the conditions he would find aboard an operational aircraft and his score is registered just as it was when he was firing .30 caliber ammunition. It gives him experience correcting stoppages, getting the feel of the turret movement, the reaction of heavier caliber ammunition and the exhilarating feeling of having at last fired a first-line aircraft weapon. All he needs now is posting to an operational squadron, and a few enemy bombers.

Except one thing. Our highly trained air gunner must now take himself off to a radio training school. All air gunners with the fleet must be qualified raidomen also. When you add it all up, you begin to wonder who is the Mr. Big in this flying Navy. The air gunner really has to know one or two things as well as the pilot.

And back in 1916-17 I was considered a qualified aerial gunner because I knew how to fire a machine gun. I wouldn't have made the fourth team in this man's war.



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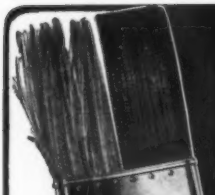

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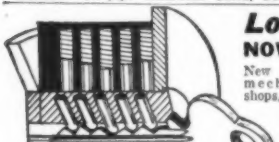

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Engineers From The Clouds

[*Continued from page 70*]

looked pretty much like another to them—a dreary expanse of rubble, craters, gaunt skeletons of buildings and twisted mounds of metal that had been planes. Their geography was getting a little hazy, and they were satisfied to let the guys from the Transport Command worry about maps. They had their own tough job laid out for them.

There was a profound hush as the transport settled heavily to the ground and began to rumble at a breakneck speed down the runway.

The plane came to a halt a few scant yards from the end of the runway. Soon its sister ships followed suit, lining up along the strip as they came in. The gliders, cut free from their tow cables, eased down gently and rolled in.

While some of the men stood guard, glider noses were unlatched and swung back on their hinges, and the side doors of the C-47's were flung back so that ramps could be hoisted into position from the floor of each plane to the ground. Then the great carriers began to disgorge their strange and complicated cargoes.

First came the company's contingent of jeeps, five in all.

Seven bulldozers were driven out on the field. These tractor-scrapers, each equipped with a six-foot blade to shove aside obstacles and level the earth, were even smaller than the jeeps. Standard full-size bulldozers used by Army engineers have 10-foot blades and weigh about 10 tons. Those midget bundles of power weighed little more than two tons.

Next came three carry-alls or dirt scrapers and removers—blades and dump carts combined, for use in slicing off earth mounds and filling in hollows so that runways can be laid. Earthbound engineers use a carry-all of eight-cubic-yards capacity, big as a one-family house. These scrapers, smaller than an upright piano, could swallow up a little less than two cubic yards of earth.

Two dwarfish graders followed, then two toy-like dumping trucks. These engineers even had their own gasoline-operated portable lighting unit, efficient enough to light up a whole airfield. Miscellaneous equipment included automatic drills, pneumatic rammers, air compressors, and synthetic rubber cells to convert midget dump trailers into water carriers.

All of this earth-moving machinery was designed and built with one thing in mind—the dimensions of the C-47's side door. When Brigadier General Stuart C. Godfrey, Air Engineer of the AAF's Directorate of Base Services, dreamed up the idea of the Airborne Aviation Engineers in the summer of 1942, he knew that every item of their equipment would have to slip through that door, which measures seven feet by four feet. It is one of the war's great engineering feats that, four months after the General's brainchild was conceived, the midget machines were rolling off

Engineers From The Clouds

American production lines. The first two companies of these cloud-hopping engineers were whipped into shape and completely equipped by November, 1942, in time to rebuild North Africa airfields for General Jimmy Doolittle after the Casablanca landings.

This company's 200 men were as unique as their machines. Lean and tough, they had gone from their civilian jobs as master mechanics and construction experts into basic engineering training at Fort Belvoir, then been handpicked for the new outfit when it was set up. For months they had been put through their paces at Westover Field, Mass., and Camp Claiborne, La.

As a result of their training these men were hard as nails and loaded with know-how to their fingertips. They knew every nut and bolt on the machines they worked with; they could crash-land or bring their equipment up on an enemy-held beach with small assault boats; they could lend a hand to aviation engineer ground crews in building roads, decontaminating gassed areas, removing booby traps and mine fields, camouflaging vital areas, and installing power or supply systems. And they could fight, as they demonstrated in Africa. As one of them put it, "We work with one hand on a bulldozer and the other on the good old rifle."

To the accompaniment of machine guns stuttering and artillery shells whistling through the near-by woods, the engineers started putting the jigsaw pieces of that airport together. They knew they weren't expected to apply the finishing touches that call for the standard heavy equipment of aviation engineer ground battalions. As a lightning-swift airborne unit, they could call it a day when the field was safe enough for planes to land. Permanent installations like hangars and steel-mesh runways could come later.

Working like mechanized beavers, they filled in craters and smoothed out rough spots, tamping down the earth with their rammers and rollers. Jagged runways began to resume their normal shape as they were scraped level and packed down hard, then covered with asphalt binding. Dangerous piles of debris were hauled away and dumped.

Long before nightfall the engineers had transformed that vast junkheap into an airport. Their portable radio relayed the terse message to battalion headquarters: "Field X ready for use."

But they weren't finished yet. In a few minutes the radio was grinding out new orders—another field to the north was already under bombardment, and the services of the airport builders would be urgently needed.

"Okay, you monkeys," the pilot of the first C-47 grinned as his passengers heaved themselves into the plane, "here we go again." He adjusted his headgear and followed them in. A few minutes later they were off, heading north with their sister ships to Castelvetrano, Gerbini, or some other unpronounceable dot on the map.

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Hotter Than Hot

[*Continued from page 62*]

in any gas. Another Suits wrinkle is to make oscillographs or photographs of sound waves passing through the arcs and then calculate the temperatures of the arcs by "reading" the pictured waves.

At nearly a hundred times atmospheric pressure, the temperature is estimated at about 11,000°F., approximately the surface temperature of the sun. Suits has produced temperatures up to 18,000°F., hottest on record, attained while experimenting with an arc under 2,700 atmospheres pressure.

Nevertheless, despite his deep concentration on refuting the old idea of "cold" science, Suits also has had time for other interests to make his own life liveable. In 1931 he went back to Madison to marry a classmate of his, Laura E. Struckmeyer. They now have two more young scientists growing up, James Carr and David Guy. Suits is a member of the Methodist church; in politics he classifies himself as being "Republican-Democrat." He has more than 50 patents to his credit, and has written an uncountable number of scientific papers.

His first patent, on an electrical device for measuring the moisture content of wood, was dedicated to the public use. While working at the Forest Products Laboratory, Suits came to realize that wood can lose or gain moisture depending on the relative humidity of the surrounding air. The structural strength of wood also depends on its moisture content. The wood could be given the proper moisture content for the community in which it was to be used, Suits said, if that content were measurable.

Suits invented a "moisture meter" using a two-element neon tube as a basis in both a measuring circuit and a fixed circuit for comparison purposes. A unique hammer electrode holder can be stuck into a piece of wood in a pile and the moisture content of the whole pile quickly determined on the spot.

Between this ingenious beginning and Suits's most important research in welding arcs were various essential but minor inventions.

But it was when he locked horns with the welder's problems that Suits hit his stride. The welding arc is hot—it has the highest temperature used in industry. The welding arc is elusive—it must be caught somewhere between the welder's electrode and the two metal edges which are to be welded. The welder and the scientist know what those two metal edges are made of; they know the electrode can be of copper, carbon, aluminum or steel. But what happens after that when the two raw edges are immutably joined, neither the scientist nor the welder knew—until Suits came along.

In a welding arc the electrons must come either from the electrode or from the pieces being welded. Their speed of travel determines the

Hotter Than Hot

temperature of the arc. The space in which those particles are picked up and tossed around is less than 1/200,000 of an inch thick. That's still as broad as several hundred layers of good solid metal atoms, but a mighty small space for the scientist to work in.

In fact, Suits quickly decided he couldn't work in that space at all, himself. The alternative was to enlarge the space. That was where his other hobby of photography came into play. If he could just take ultra-speed pictures of those arcs, enlarge them, and slow them down perhaps he would have the answer to what happens inside the welder's arc.

Still, the arc moves so fast and is so hot he had to have a constant—something stable and controllable with which he could make comparisons of speed and temperature—something which would not deteriorate in the heat of the arc. This ruled out substance as a constant, for the extreme heats would reduce any substance.

Color was possible, but, although arcs in various atmospheres have various color properties, individual arcs do not vary in color within themselves sufficiently to be measureable. Light intensity as a constant was also possible, but only possible. It was ruled out for the same reason as color.

What else could work within such a small space and be unaffected by either the speed of the arc or its temperature? What about sound? Dr. Suits thought it over. Sound? Now there was something. A sound wave could be held constant in itself, would not deteriorate in heat, could be photographed — well, maybe sound *was* the answer!

As long ago as 1873 the use of sound was suggested as a means of measuring the temperature of a gaseous medium. In practice the sound wave from a spark discharge is passed through the gas column and received on the other side by a second spark discharge which acts as a microphone.

Such high-intensity sound waves were early found to be photographable because of their refraction shadow. The combining of two such unrelated scientific phenomena—heat measurement and photography—was Suits's genius.

After that it was only a matter of devising the measuring equipment, of calibrating different temperatures for different arcs and different metals. It was a matter of turning the laboratory results over to industry for the improvement of electric arc welding.

Thus came about Suits's greatest contribution to America and the world. For though the contribution, like everything else, works now for war, no one quite dares envision all its stupendous possibilities when peace at last is won.

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Return Of The Spearfish

[*Continued from page 56*]

patient and would not easily be foiled. The hydrophones had told him all they could during the morning. To listen longer would merely increase the nervous tension inside the boat. The crew were behaving normally, yet it was difficult to refrain from listening and wondering what the noises portended, so he ordered the man on listening watch to go off duty.

"I decided on complete silence and remaining stopped on the bottom as the only hope of survival," he said afterwards.

Although the operator no longer listened at the hydrophones, the sounds could not be kept out of the boat. They penetrated the hull for all the crew to hear.

The sound of a depth charge came to them just before 1:30 and five followed within the next three-quarters of an hour. Some were nearer than others, but none was near enough to shake the Spearfish.

For a time there was silence. Then just before 3 o'clock the attack started again. Twenty-eight times in an hour the Spearfish shook under the force of the explosions.

Then at 5:20 p.m. came an appalling explosion. The hull of the Spearfish seemed to close in on the crew as though under a gigantic press and then spring outward again. The lights were shattered. In the darkness the shaken men heard the deadly sounds of spurting water and the sibilant hiss of escaping air.

The voice of Lieutenant Eaden came to them out of the darkness. It was quite normal, as though nothing unusual had happened, a steadying, reassuring voice: "Go quietly to diving stations, use the secondary lighting and investigate damage. Don't make any noise," he ordered.

The men moved to their posts. Soon the emergency lights came on, and reports of the damage began to reach the captain.

"The port main motor cooler has burst and the switchboard is covered with water, sir," said F. H. Westnutt the engineer. Hissing air told of serious leaks in the high-pressure air system. Water ran down the ventilator from the main battery, but bad as things seemed, the commander found comfort, for he realized there was no immediate danger of the Spearfish flooding, that her structure, over which the shipwrights had toiled to make it as strong and perfect as possible, was still intact.

"Fit new light bulbs and sweep up the broken glass," the commander ordered. "And try to stop the leaks of the high-pressure air."

Another depth charge exploded at a distance, then one near enough to shake the Spearfish as though she weighed no more than a few pounds instead of hundreds of tons. At intervals came more explosions until they totaled a dozen, some at a distance, others near enough to rock the submarine. After which things quieted down awhile.

"Issue a tot of rum," ordered the captain at 6 o'clock. They all took it appreciatively. It was eleven hours since the first explosion shook the ship, and during that time they had been under great strain.

The air began to get fouler. To conserve it, the captain ordered all the crew to lie or sit down. His keen eye noticed that several men were breathing more heavily than usual. It was then that Lieutenant D. A. Pirie, who remained as cheery as any man aboard, bethought himself of a bottle of candy which he possessed. It was passed round and proved a boon to the men.

Knowing the increasing foulness of the air would force them to the surface within an hour or two, the captain dealt with his secret papers and ordered a big charge of explosive to be rigged ready to destroy the ship and its secrets.

At 7:20 that evening he called the officers and crew together. "I would first of all like to congratulate you on your steadiness and fine behavior," he said. "What I propose to do is to blow the ship to the surface at 20:30. If the enemy is in sight we shall engage them. If not, we shall make our way home."

Half an hour before blowing the tanks, another examination was made of the damage. The hull leaked in several places, fuel and oil tanks were leaking, fractures were found in one of the main engines, the steering gear was out of order, the voice pipes from the control room to the bridge were broken, the internal telegraph system was out of order, a periscope and the wireless were smashed, while the after hydroplane had jammed owing to the shaft being forced out of alignment. Altogether 39 different items of the intricate electrical apparatus and other machinery were damaged by the explosion. Yet neither the cap-

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tain nor a single member of his crew was dismayed. They were badly knocked about, but they were not knocked out and they still had a fighting chance of survival.

Trying his controls, the captain found the fore hydroplanes worked freely. Then he gave orders to blow the main ballast tanks.

As the tanks emptied and buoyancy returned to the Spearfish she rose to the surface.

Selecting his leading signalman, a man weighing 14 stone, the captain instructed him to hang on his legs, to prevent him from being blown out when he opened the hatch. Directly the hatch was unfastened, the pent-up air gushed out with such force that the binoculars round his neck flew up through the opening and were only saved by their strap from going overboard. He gazed around him, and drew the fresh air into his lungs. No enemy was in sight.

Fortunately the starboard electric motor still operated and on this the Spearfish moved slowly forward while the engineers and every man on board strove to repair the damage wrought by the explosion. Pipes were examined and leaky joints tightened. The engineer, F. H. Westnutt, struggled to get the main engines running. Water had got into both and put them out of action, their valves would not work. But fault after fault was traced and rectified until at last after struggling for three hours he got the starboard engine turning. It vibrated a bit, but he had never heard a sweeter sound in his life. Then he turned to tackle the port engine and managed after another fight lasting two hours to clear the water out of it and set it humming. So their chances of escape began to increase.

In the morning the wireless operator got his wireless going to warn other British submarines in the area. Then he passed a signal to base.

In due course the signals called the ships of the Royal Navy to see the Spearfish safely home. Eight minutes after that signal was received, the first cruiser left port. Such prompt action proved that the Navy was awake. As quickly as possible the destroyers and other forces followed. Never was a submarine provided with a mightier rescue force. If only the German Navy had intervened to try to cut off the Spearfish, there would have been one of the big naval battles of the war.

About 8 o'clock that night she set out in the dark to make her rendezvous with the destroyers Somali and Eskimo. At midnight in the appointed place she picked up her escort, and the Spearfish made a safe return.

Less skill on the part of Lieutenant Eaden, a little less luck, and the Spearfish might have remained for ever at the bottom of the North Sea.

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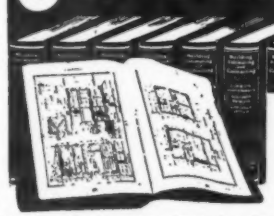

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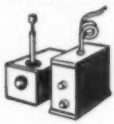

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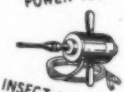

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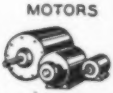

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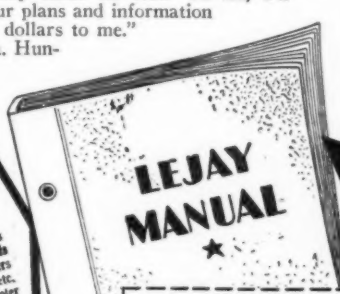

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